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HIGH-SPEED TELEGRAPHY.

By CHAS. H. GARLAND.

LAST year the lovely little town of Como held a great *fête* to celebrate the Volta centenary. Truly it has cause for pride. The town made famous by the two Plinys was the birthplace of the man who discovered a force which bids fair to revolutionise the industry of the world. In discovering the pile, the forerunner of all the electrical batteries we know to-day, Volta made possible the production of the first constant current of electricity, and thus laid the foundation of all later developments.

A part of the celebrations consisted in a Congress of telegraph experts from all corners of the civilized globe. The world was ringing with the name and fame of Marconi, a native of Bologna, and the attention given to his wireless telegraphy absorbed the public interest, so it escaped notice that at one of the sittings of the Congress, Hofrath Josef Kareis, of Vienna, gave a brief description of one of the most striking inventions of modern times—the work of Anton Pollak, a Hungarian electrician, and Josef Virág, a Hungarian mechanician. It was claimed for this marvel that it could transmit telegraphic messages over long distances at the astounding rate of sixteen hundred words per minute.

In order to understand the full significance of these figures, we must take a brief glance at modern telegraphy and the speeds hitherto attained. Nearly the whole of the English telegraph work is carried out by some adaptation of the Morse system, involving the use of certain signals produced either by some printing apparatus for sight reading, by some sounding apparatus for reading by the ear, or by any other method which will appeal to the senses. It is employed in flag signalling, lamp and heliograph signalling, and in some half-dozen systems of telegraphy. The short and long signals, however produced, are known as "dots" and "dashes." Thus, a dot followed by a dash is A. A dash followed by three dots is B. Dash, dot, dash, dot, is C, and so on.

The fastest method of telegraphy, unassisted by automatic appliances, is known as the "sounder." This is essentially a small hammer which, in response to currents sent from the sending office, strikes upon a brass upright and produces a short or longer tap, which the listening telegraphist translates into writing. By this system a good telegraphist can send and receive, for a short period, as many as 45 words per minute. The speed at which a clerk can receive is limited, for all practical purposes, by the speed at which he can write. So for an apparatus which is read by sound, and leaves no printed record of the signals which can be afterwards transcribed, a higher speed is useless.

There are on the average three signals to each letter of the Morse alphabet, and the length of the telegraphic word is, as a rule, five and a half letters. In order, then, to receive 45 words in a minute, a telegraphist must discriminate the various characters of 720 signals or taps. As the space between the taps is of almost equal importance with the taps themselves, he has to measure the length of an equally large number of silent intervals. A clearer idea of what this speed means can be obtained if we remember that a watch ticks about 160 times per minute.

In the Wheatstone system the sending is done by means of an automatic transmitter. The perforating of the ribbons is performed very rapidly, and I have seen telegraphists work at the rate of over 50 words per minute. A large number of telegraphists can be employed in preparing ribbons which may be continually passed through the transmitter at the rate of 400 words per minute. This means that 6,600 signals are sent over the wire in one minute, a speed seldom exceeded in actual working.

At the receiving office the signals are printed on a narrow green ribbon, and consist of shorter or longer black lines, which represent the conventional dots and dashes. When the green ribbon has been received it is cut up into sections and distributed among a number of writing clerks, who transcribe it. In this manner it is possible to keep a large number of clerks fully employed at either end of the wire, and so avoid what is the chief expense in telegraphy—the building of new trunk lines and maintaining them in repair.

Up to the time of the invention of the Pollak-Virág system, the Wheatstone automatic telegraph was the most rapid of the high-speed telegraph systems. It is true that an American system, invented by Crehore and Squire, attained a tremendous speed in the experimenting room, but the details were so complex, and the electrical difficulties so great, that it was never put to practical use.

The Pollak-Virág telegraph will send 100,000 words

over a long wire in one hour. This is over 1600 words per minute. A column of the *Times* newspaper contains a little over 2000 words. A page of this magazine, without pictures, is about 1000 words. So this wonderful telegraph apparatus could send nearly two pages of this magazine in one minute, and at the same time, print it on another receiving apparatus three or four hundred miles distant.

Some two years ago, Anton Pollak, a native of Szentes, in Central Hungary, brought to the United Electrical Company, of Buda Pesth, this untried system of telegraphing at a high speed. The firm, after some deliberation, set up a special laboratory for the purpose of carrying out experiments, and secured the co-operation of the well-known physicist and mechanician, Josef Virág. The results of the experiments on an artificial wire were so satisfactory that it was decided to test the apparatus on a real working wire. By an arrangement with the State telegraph officials, four wires were connected with the laboratory of the Electrical Company from the Central Telegraph Office at Buda Pesth. These wires were in turn connected from the Central Telegraph Office to Temesvár, a town about 200 miles away. The ends of the wires at Temesvár were joined together, and so, although both the sending and receiving apparatus were in the laboratory at Buda Pesth, the messages actually passed over a wire of over 400 miles in length. In order to test every condition the experiments were tried first in fine dry weather and then in wet weather. Copper wires were at one time used, at others iron wires. The best results came from the use of copper wires, but the results were always good. Over this wire of 400 miles in length, passing through open country, messages were transmitted at the speed of 100,000 words per hour. Even then the speed of the apparatus was not at maximum.

The fame of the apparatus having reached America, Messrs. Pollak and Virág were invited to carry out some experiments for the Western Union Company, and these trials were attended with the most satisfactory and even surprising results. In all cases the ordinary working lines were used, and not only was the high speed of the Hungarian experiments equalled, but in one notable instance, over a wire from Chicago to Milwaukee, the phenomenal speed of 155,000 words per hour was attained. In very stormy and wet weather a trial was made over the one thousand miles separating New York from Chicago. Despite the unpropitious conditions prevailing a speed of 65,000 words per hour was attained and maintained. The inventors express themselves more than satisfied with this demonstration of the practical commercial value of their invention.

What is the marvellous apparatus which produces this result? It is an ingenious combination of the telegraph, the telephone, and photography. In order to understand this extraordinary combination, which, like all great inventions, is fundamentally simple, we must know something of two electrical principles.

First and most important comes the battery. The battery is the generator and source of the electric current. A battery is merely two plates of dissimilar metal immersed in a bath of some chemical mixture—the most common metals used being zinc and copper. In order that a current may flow there must be a complete path for it from the copper back to the zinc. It is possible to bury the wire which goes from one end, or pole, of the battery in the earth, and if the end of the other wire, which may be hundreds of miles away, be also buried in the earth the current will find its way back. Now if we had a battery with the zinc end wire buried in the earth, and the copper end wire joined to another wire, which, some miles away, was buried in the earth, a current would flow along the wire from the battery, into the earth and back again, *viâ* the other buried wire. If we turned the battery round and joined the copper end to the buried wire, and the zinc end to the wire which went to the distant station before it was buried, we should have a current flowing in the reverse direction, viz., into the earth, away to the distant buried end of the trunk wire, and back to the battery by way of the trunk wire. This is the first principle we must understand: that the direction of the flow of a current in a wire can be reversed by reversing the connections of the battery.

We must also be familiar with the action of the current on a magnet. If we wind a piece of wire round an iron nail and send a current of electricity through the wire the nail becomes a magnet, with all the powers of a magnet to attract and repel. When the current is stopped the nail ceases to be a magnet. When the current is reversed the poles of the magnet are also reversed. If, however, we use an ordinary permanent magnet instead of a piece of iron, we shall get the following effect. Suppose we have a wire wound round the north pole of a magnet, and pass through the wire an electric current in the direction which would make it a north pole magnet if it were a plain piece of iron. The result is that the strength and attractive power is increased. Now suppose we reverse the direction of the electric current, sending it in the direction which would make a south pole magnet if we were dealing with a plain piece of iron. The effect is to lessen or entirely counteract the attractive power of the permanent magnet. This is the other principle we must understand—a current of electricity passed through a wire wound round a permanent magnet will increase or decrease its attractive power according to the direction of the current.

The apparatus by which the messages are sent is really a device for changing the direction of the flow of the electric current in the wire. The messages are first prepared on a perforated paper ribbon, which has two rows of perforations. (Fig. 1.) The upper row

FIG. 1.—Photograph of the perforations in the sending slip of the Pollak-Virág Telegraph. The central line of perforations are for guiding purposes.

corresponds to the "dashes" of the Morse alphabet, the lower row to the "dots." This ribbon is then passed over a metal cylinder (Fig. 2) connected with the wire which goes to the distant station. On the top of the ribbon two little metal brushes press, one of which is connected with the copper pole of the battery, and the other with the zinc pole. When a perforation in the paper ribbon passes under one of the brushes, the brush touches the metal cylinder beneath, and a current is sent. If one of the top row of holes passes, the brush which is joined to the copper end of the battery touches the cylinder, and a current flows along the wire to the distant station, and back, through the earth, to the zinc end of the battery. If one of the lower row of holes passes, the brush which is connected with the zinc end of the battery touches the cylinder, and a

current flows in the opposite direction, viz., through the earth to the distant station, and back, through the trunk wire, to the battery. The holes in the paper are so arranged that only one brush can touch the cylinder at one time. So, according to the arrangement of the

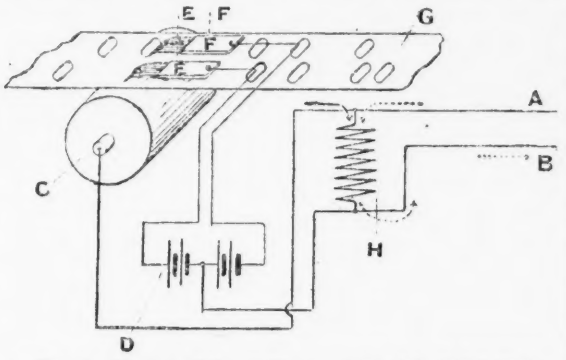


FIG. 2.—Diagram of the sending apparatus of the Pollak-Virág Telegraph. A. Trunk or line wire; B. Earth or return wire; C. Metal cylinder; D. Battery; E. Positive electrode or brush; F. Negative electrode or brush; G. Perforated sending slip; H. Self-induction Coil for neutralising inductive disturbances on line.

holes on the paper ribbon, we have currents sent to the far-away office which sometimes flow in one direction and sometimes in the other. A large number of clerks prepare the paper ribbons, and the sending apparatus can be fed at the pace required. This is extremely simple and easily followed on the illustration.

Now as to the receiving arrangements. These consist, first, of a fairly powerful bar-magnet fixed in a kind of box having one side composed of thin metal, or ferrotype. The magnet is fixed in such a manner that it draws in the metal side to a slight degree. Round that part of the magnet which is near the metal side, or diaphragm, of the box, is fixed a coil of fine wire. The

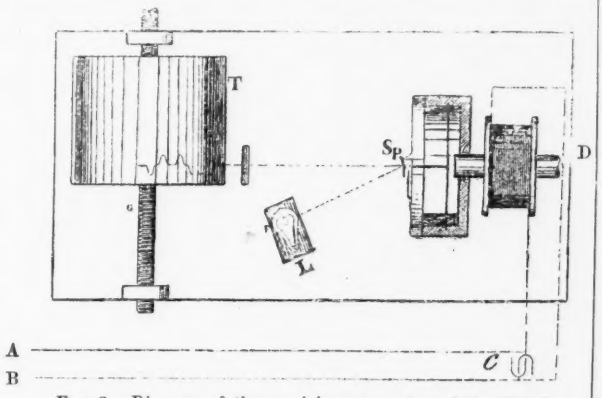


FIG. 3.—Diagram of the receiving apparatus of the Pollak-Virág Telegraph. A. Trunk or line wire; B. Earth or return wire; C. Condenser for neutralising disturbances due to the "Capacity" of the line; D. Coil; Sp. Mirror; L. Electric glow-lamp; T. Drum of sensitized paper.

disposition of these parts can be easily distinguished in Fig. 3. Remembering what has been said above about the effect of an electric current on a magnet, we can see what would be the result of a current passed through the coil of wire fixed on the end of this magnet. The end of the magnet near the diaphragm is a north pole. The wire on the coil is wound in such a way that when the current flows from A to B the power is increased, whilst when it flows from B to A the power is decreased. The result of increasing the power of the magnet is to draw the metal diaphragm nearer, whilst if the power is decreased, the diaphragm is released, and draws away from the magnet. With the sending apparatus previously described the current is sent sometimes in one direction and sometimes in the other. The diaphragm answers to this change in the direction of the current by swerving towards or away from the magnet. But at the pace of 100,000 words per hour, the diaphragm would move 26,400 times per minute. So some means had to be devised to register these movements in an intelligible way. This is done by enlisting the aid of photography in the following ingenious way.

In front of the diaphragm is fixed a large magnet made in a peculiar manner. It is curled round somewhat like a horse-shoe. One end of it is cut into two points, the other end into a pointed weak spring. A tiny mirror (Fig. 3, Sp) with a small plate of iron fastened to its back is suspended to the two-pointed end, which holds it by magnetic attraction. The spring end of the

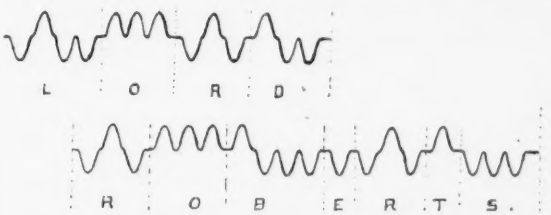


FIG. 4.—The words "Lord Roberts" as they would appear when written in the Morse code by the Pollak-Virág Telegraph.

magnet touches another tiny iron plate on the back of the mirror. A very small light metal rod is fixed to the middle of the diaphragm, and to the spring end of the magnet. Now if the diaphragm moves, this rod communicates the movement to the spring, which in turn moves the mirror. The two-pointed end of the magnet acts as a sort of hinge with practically no friction, upon which the mirror swings.

Some little distance from the mirror, a small electric glow-lamp is placed, which throws a light on to the reflecting surface. This light is reflected on to a drum covered by sensitized paper. These details can be easily followed in Fig. 3.

When the diaphragm is drawn inwards the lower end of the mirror is drawn back and the light ray is depressed. When the diaphragm moves away from the bar-magnet the lower end of the mirror is thrust forward and the light ray is raised. This results in a line on the sensitized paper, which rises sometimes in waves above the central line, and is sometimes depressed in waves below the central line. The waves above the line represent the "dashes" of the Morse alphabet, those below represent the dots. In Fig. 4 the words "Lord Roberts" are given as they would be indicated by these waves. After the message has been sent, the sensitized paper is taken from the drum and the marks are "fixed," a process occupying about two minutes, and then the message is ready to be written up by a clerk.*

* Herr Pollak writes to me as follows:—'We are now using endless slips and diagonal writing combined with an automatic system of development, so that messages are ready for transcription immediately on receipt."

These are the arrangements by which this marvellous rapidity of telegraphing is carried out. There were many technical difficulties in the way of its realization, but these have all been overcome by the same ingenious methods applied to the details, and one of our illustrations (Fig. 5) is an actual reproduction of a message received at the rate of over 1600 words a minute on a wire some 404 miles in length. The possibilities of this system seem almost infinite. In cases where the number

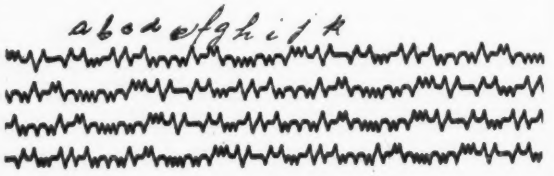


FIG. 5.—Photographic reproduction of an actual message written by the Pollak-Virág Telegraph at the rate of 100,000 words per hour. The message consists of the letters of the alphabet A—K repeated continuously.

of wires is limited, such as in a long submarine cable, the carrying power is multiplied in an astounding manner. Fancy being able to send a column of this magazine, about 500 words, to America in twenty-two seconds. Take an ordinary newspaper of 40,000 words, for example. It would pass over the wire by this system in twenty-five minutes, whilst on the Wheatstone system it would occupy one hour and forty minutes. With a Morse sounder working as rapidly as the fastest operators could work it would occupy nearly fifteen hours. A message of 500 words occupies about 30 yards of slip by the Morse system. The same message by the Pollak-Virág system barely covers a piece of paper measuring 5 feet by 10 inches.

THE PYGMIES OF ASIA.

By R. LYDEKKER.

So recently as the year 1858, when they were selected as a convict settlement by the Government of India, the group of islands in the Bay of Bengal known as the Andamans were practically cut off from the rest of the world; and no definite knowledge was extant in Europe as to the peculiarities of the natives by whom they were inhabited. It is true that the existence of such aborigines had been ascertained long before, Arabic writers of the ninth century having referred to them, while they were also mentioned at a later date by the Venetian traveller, Marco Polo. Moreover, so far back as the year 1788, the East India Company attempted to form a penal station on these islands, which was, however, abandoned a few years later without any accurate information having been obtained with regard to the affinities and characteristics of their aboriginal inhabitants. This lack of information with regard to the natives appears to have been largely due to the reputation they had gained for ferociousness and hostility to strangers, in consequence of which they were avoided as much as possible by the officials sent to establish the proposed settlement. To a certain extent this was a fortunate circumstance, as it prevented the native race from being contaminated by foreign admixture until a much later period, when competent observers were fortunately among those stationed by Government on the islands.

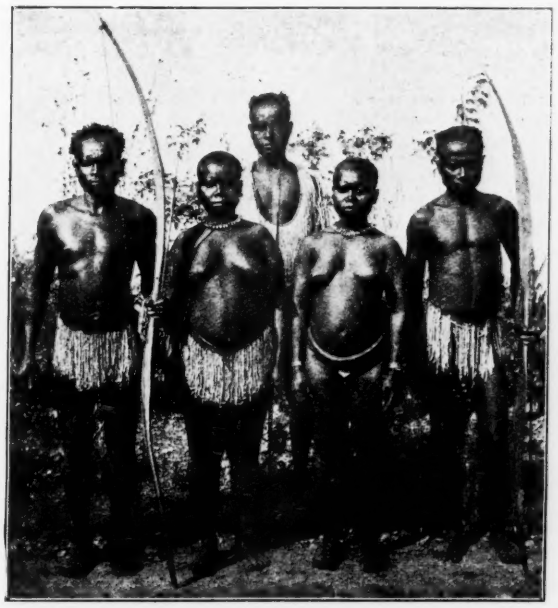
A glance at the map of Asia will show that the Andamans have their longer diameter running nearly due north and south, and that they form the central and main portion of a curved chain of islands commencing off Cape Negrais—the southern extremity of Aracan—and terminating in the Nicobars; and it seems highly probable that this chain originally formed a peninsula, with its axis running parallel to that of Tenasserim. The southernmost island of the group is the imperfectly known Little Andaman, while the other three main islands, which are separated from one another by narrow channels, and are respectively named North, Middle, and South Andaman, collectively constitute Great Andaman. The total length of the latter is 140 miles, with a maximum breadth of 20 miles.

To the anthropologist these islands are of surpassing interest from the circumstance that their native inhabitants are the purest representatives of a race of diminutive round-headed, Negro-like people, peculiar to South-eastern Asia, and definitely known elsewhere only in the Malay Peninsula and the Philippine Islands. Even in the Nicobars these Negritos, as they are called, are quite unknown, the natives being more or less closely connected with the Malays. By the older writers the aborigines of the Andamans were universally called "Mincopies," but as there is no clue to its origin, this term, which is unknown among the natives themselves, has now given place to the appellation Andamanese.

Although having the characteristic frizzly, or "woolly," black hair of Negroes, and also agreeing with that type of mankind in the relative proportions of the limb-bones (especially the shortness of the humerus, or upper arm-bone, as compared with the bones of the fore-arm), as well as in the form of the pelvis and the large size of the teeth, yet the Andamanese do not show the characteristic Negro features in their full development. The jaws, for instance, are less projecting, the lips thinner and not so prominent, and the nose narrower and less flattened; so that the coarser features of the Negro type may be said to be softened or "toned" down to a remarkable degree. Whether the Andamanese or the Negro type is the more primitive may be left an open question. A further important point of difference from African Negroes is to be found in the shape of the skull, which is of the round instead of the long and narrow type; the relative breadth is, however, by no means so great as in certain other round-headed races. As regards height, the Andamanese present a very marked contrast to Negroes, some of whom, like the Zulus, are very tall. According to Mr. E. H. Mann (formerly assistant superintendent of the islands), the average height of the men is only 4 feet $10\frac{3}{4}$ inches, and that of the women 4 feet $7\frac{1}{2}$ inches; the tallest man measured by that observer being 5 feet $4\frac{1}{2}$ inches, and the shortest woman 4 feet 4 inches.

The skin does not appear to be absolutely black; but there is some degree of discrepancy in this respect between the accounts given by different observers. The late Professor V. Ball, who visited the Andamans in 1873, states that the colour of the skin is generally obscured by the red clay, grease, or wood-ashes, with which the Andamanese are in the habit of anointing themselves, and that its real tint is only revealed among the well-washed orphans at Port Blair. In fact, the more an Andaman islander washes himself the blacker he becomes! The hair of the Andamanese, like that of other Negritos, is disposed evenly over the scalp in close

spirals, and not in the separate tufts, with intervening bare spaces, characteristic of the Bushman type. While generally black, it may sometimes be very dark brown in colour. In some instances the hair is allowed to grow to its full length, but it is very frequently (as in the accompanying illustration) partially or completely



Group of Andamanese at the Calcutta International Exhibition, 1883-84.
Photographed by COLONEL WATERHOUSE.

shaved. Professor Ball mentions meeting a large party of Andamanese none of whom possessed a hair on any part of their bodies. In mourning the head is invariably shaved.

Previous to the founding of the European settlement at Port Blair, in the neighbourhood of which certain regulations are now enforced with regard to clothing (as in our illustration), the Andamanese were in the habit of going about in a perfectly nude condition, save that the women wore a leaf suspended from a girdle made of the fibres of rattan or the screw-pine. This absence of dress is probably to some extent due to the nature of the Andaman climate, which renders it unnecessary to keep the body warm by artificial means. With the exception of a small, and probably introduced, race of wild pigs (whose flesh afforded an important food supply), the islands are inhabited by no animals larger than palm-civets, and even of these the natives never learnt the art of dressing the skins. Neither did they practise agriculture nor attempt to domesticate the indigenous pigs and jungle fowl, but lived entirely by hunting and fishing, and on such edible roots, fruits, and berries as grow naturally in the jungle. In addition to pork, their animal food included the flesh of palm-civets, dugongs, monitor lizards, turtles, and occasionally porpoises, together with turtles' eggs, fish of various descriptions, prawns, shell-fish, and even the larvæ of large wood-boring and burrowing beetles. The hostility displayed to strangers (apparently largely due to kidnapping raids on the part of Chinese and Malays) not improbably gave rise to the statement that the Andamanese were cannibals; but this charge has been completely disproved.

Both sexes were thoroughly at home in the water from an extremely early age, and the creeks and straits of the island were navigated in dug-out canoes and outriggers of home manufacture. Home-made clay pots, either partially baked by fire or dried in the sun, formed their domestic utensils; and for capturing game and fish they employed bows and arrows, spears, harpoons, and nets. With the latter, says Mr. Mann, they take fish more readily than the most skilful angler. In modern times their spears and arrows have been tipped with bone or shell, but in the old refuse heaps of the islands polished arrow-heads and adzes of stone have been discovered, evidently manufactured by the forefathers of the present aborigines. And it has been suggested that the use of stone has been superseded by shell and bone owing to the greater facilities with which the two latter substances are worked. Till within a comparatively recent time chips or flakes of flint were, however, still used for shaving, although these have now been completely superseded by glass. Professor Ball relates how he witnessed the manufacture of such glass flakes by a woman who chipped them off from a piece of dark bottle-glass with a pebble. "Having struck off a flake of suitable character," he writes, "she forthwith proceeded, with astonishing rapidity, to shave off the spiral twists of hair which covered the head of her son." But even at this date (1873) the writer was informed that the art of making flint-flakes was entirely lost; the process of flaking being facilitated by first heating the stones in a fire. Serviceable knives were manufactured from a large bivalve shell to be met with in numbers on the shores of the islands.

The mention of fire affords an opportunity of referring to the extraordinary circumstance that although the Andamanese were well acquainted with its use (always eating their meat and fish in a more or less cooked condition), yet they were totally unacquainted with any method of producing it. According to the legend, fire was originally obtained from a volcano in Barren Island, situated to the eastward of the Middle Andaman; and it was ever since kept going by maintaining a constant supply of smouldering or burning wood.

In addition to strings of shells, the women wear the skulls of deceased relatives as ornaments. Red clay is employed for daubing the skin; but during periods of mourning, when the head is shaved, this is replaced by a uniform coating of white clay. Allusion has been already made to the girdles and fishing-nets of vegetable fibre, and the latter is also employed in the manufacture of baskets and sleeping mats. As an amusement, the men are fond of making "cat's cradle" with pieces of string, and as the same game is practised by the Dyaks of Borneo and other Malay tribes, it was probably imported into the Andamans from the East, as it can scarcely be regarded as a survival from the original Negrito population of the Malay Peninsula. The dwellings of the Andamanese are of a rude and primitive type, but these are not all alike, the most simple being mere shelters of leaves and boughs, which are usually erected only in temporary encampments and not in the permanent villages.

Although subject to passionate outbursts of temper, during which arrows may be shot recklessly among friends and relations, the Andamanese are described by all who have known them well as singularly amiable and kind in their mutual relations; and in many respects they resemble the Melanesians, being merry,

XUM

talkative, inquisitive, restless, prone to resent an injury, but fond of a joke so long as it does not assume a practical form. From the majority of savage peoples they stand out in pleasing contrast on account of the treatment accorded to the women by their husbands. A man has but one wife, to whom he is nearly always faithful throughout life, and whom he regards as an equal, and treats with an affection which might be copied by some civilised people. Like many savage races, the Andamanese have evolved a complicated system of marriage prohibitions between relatives, and they have likewise regulations as to the particular kind of food they may or may not eat at certain seasons of the year, as well as superstitions with regard to uttering certain words or names. But to mention these and many others of their customs would exceed the limits of my space. There appears to be no form of recognised worship, yet there is a vague belief in a supernatural being (*Puluga*), whose dwelling-place is in the sky, and who created all living creatures with the exception of a few evil spirits whom he is unable to control. Thunder is supposed to be a manifestation of the wrath of this supreme being, who is credited with the curious incapacity of being unable to understand human thoughts during the hours of darkness, although he is capable of so doing during daylight. The absence of any traditions among the Andamanese of the arrival of their forefathers from some other part of the globe may be taken as confirmatory of the physical evidence as to their long tenure of their present home. By the aborigines the Andaman Islands are indeed regarded as alone constituting the world; and the few strangers by whom they were visited in the early days of their history were looked upon as their own departed ancestors. The islands themselves are believed to be supported on a lofty tree, one day destined to be overthrown by an earthquake, when they will be re-occupied by the deceased predecessors of the present inhabitants.

As regards arithmetical power the Andamanese stand on an exceedingly low platform, as they have only words for one and two. If they desire to express a higher number, some word indicating several or many is usually employed, but even then about six or seven seems to form the limits of their arithmetic. A few specially gifted individuals are, indeed, able to indicate ten by tapping the nose successively with the ten fingers and then holding up the two hands, but beyond this none are able to go.

In spite of this exceedingly low development of calculating power, the Andamanese have succeeded in evolving a remarkably complex language, of which each of the nine tribes possesses a dialect of its own. Into the characters of this language it is impossible to enter on the present occasion, but it may be mentioned that it appears to have no close affinity with any other known tongue, and consequently sheds no light on the origin and relationship of the race by whom it is spoken.

In spite of every care exercised by those in authority, the establishment of the convict settlement at Port Blair has produced the results universally observed when a primitive and long isolated people are first brought into contact with higher races. The newly introduced habits, diseases, and vices soon told with fearful effect on the aborigines; the pure-blooded race showing a marked tendency to die out and to be replaced by half-breeds. In 1891 the number of pure-bred Andamanese was stated to be less than 4000, and there is little doubt that their eventual fate, like that which has already befallen the Tasmanians, is complete extermination.

If we now enquire as to who are the nearest relatives of the Andamanese, and whence they came, we shall be confronted with a considerable amount of difference of opinion on the part of those who have paid most attention to the subject. By some it has been supposed that a Negrito population is to be met with in the more remote hill districts of India, China, and all the Malay countries, as well as in New Guinea, and that these presumed Negritos indicate the original population of South-eastern Asia before the time that it was overrun by Mongolo-Malayan tribes. And it has been further considered that there is no intimate relationship between the true Negritos of the Andamans and the long-headed Oceanic Negroes of Papua and Melanesia.

These views have, however, been recently opposed by Dr. A. B. Meyer, the learned Director of the Dresden Museum, who attaches comparatively little importance to round heads and long heads, and is of opinion that, in addition to the Andamanese, and apart from Papua, the only Negritos definitely known to exist in Asia are confined to the Malay Peninsula and the Philippine Islands. Moreover, according to the same authority, Negritos, in place of having no near kinship with the long-headed Papuans and Melanesians, are their very intimate relations, there being no evidence to support the view that the round-headed individuals occasionally met with among the two latter indicate the remnants of a distinct Negrito race.

If these opinions represent the true state of the case, and if, as has been suggested in previous articles of the present series, the Australian aborigines and the primitive tribes of India and Ceylon are related to the Caucasian rather than to the Negro type, it will be evident that the Negro element occupies a much less important position in South-eastern Asia than has been commonly supposed. Unfortunately, however, no definite light is thrown on the problem whether the birthplace of the Negro stock should be sought in Africa or in Asia.

Putting aside such theoretical questions, the short remaining space may be devoted to the nearest living relatives of the Andamanese. The existence of Negroes of small stature in the Philippines appears to have been known to the Chinese at the commencement of the thirteenth century, and the name Hai-tan was applied by them to the people in question. These small, black, frizzly-haired people were subsequently encountered by the Spaniards when they colonized the Philippines, and as they were first seen in the mountains of Luzon, they received from their conquerors the title *Negritos del Monte*. They are accordingly the typical "Negritos." Their native name is Aïta, Ita, or Inagta, which means black, being akin to the Malay *itam;* and it is possible that the Chinese designation *Hai-tan* may have a similar meaning. The average height of the men is 4 feet $8\frac{3}{4}$ inches, and that of the women 4 feet $6\frac{1}{2}$ inches. Not only in physical appearance, but likewise in several of their moral characteristics, these little Negroes resemble the Andamanese, and it is a highly significant fact that they are likewise faithful to their marriage vows and have but one wife each. Negritos are likewise also found in other islands of the Philippine group, such as Mindoro, Panay, Negros, Mindanao, etc.; but our information concerning all of them is extremely deficient. The only other region where Asiatic pygmies are known to occur is the Malay Peninsula; but our lack of knowledge of them in that area is, if possible, even more conspicuous than in the Philippines.

ASTRONOMY WITHOUT A TELESCOPE.

By E. WALTER MAUNDER, F.R.A.S.

VIII.—FOUR VARIABLE STARS.

IT is 304 years since David Fabricius, one of the earliest observers of sunspots, noticed that a star in the neck of Cetus the Whale, which he had observed in August, 1596, to be of the 3rd magnitude, had disappeared by October. This appeared an observation of great importance, since it seemed to show that the fixed stars are not all of them permanent, but that they might die out. Seven years later Bayer recorded a 4th magnitude star in precisely the same position as that which Fabricius had noted to have disappeared. Here, however, the matter rested for an entire generation, and it was not until 1638 that Holwarda detected the star again as of the 3rd magnitude in December, but found it disappear in the following summer to reappear again in the autumn. This star, therefore, Omicron Ceti, which received from Helvelius the name of Mira, the wonderful star, was the first to become known as a periodic variable.

The first star, that is to say, in historic times. There is another more striking even than Mira, which it seems likely was noted by the forgotten astronomers of Arabia or the valley of the Euphrates centuries before even Hipparchus and Ptolemy compiled their catalogues. This is Beta in the constellation Perseus, described by Ptolemy as the principal star in the head of the Gorgon Medusa, which the hero is represented as carrying in his hand. This star has come down to us from the Arabs with the name Algol, the Demon Star, and it is at least a probability that it owed this name to the fact that though ordinarily of the 2nd magnitude it sinks down almost to the 4th at perfectly regular intervals of two days and twenty-one hours.

The variability of Algol was discovered in modern times by Montanari in 1669, and it was re-discovered by Goodricke in 1782. The latter observer two years later added two other variables to the list; Beta Lyræ with a period of very nearly thirteen days, and Delta Cephei, with one of five and a-third days. At this date scarcely more than a century ago these four stars were almost the only variables known to us, and variables continued to be rare objects until the middle of this century. Now their numbers have been added to so greatly that the catalogue prepared by Prof. Chandler in 1896 comprises 400, the variability of which is fairly well established, and new members of the class are being discovered every month.

These four stars are all well in view during the September nights. Delta Cephei being a circumpolar is necessarily always visible, and is now overhead at midnight; Algol also is a circumpolar, but descends too near to the northern horizon at its sub-polar transit for observation then. At midnight on September 1, however, it is high up and almost due east of the observer, whilst Beta Lyræ is at a similarly favourable elevation in the west. Mira Ceti being slightly south of the equator is only above the horizon about 11½ hours out of the 24; it comes to the meridian at midnight towards the end of October, consequently at midnight on September 1 it is low down in the south-east.

Mira Ceti has been somewhat irregular in its period of late, but should have just passed a maximum. Its brightness at maximum varies through wide limits; sometimes it scarcely exceeds the 5th magnitude, sometimes it is distinctly brighter than the 2nd, but usually it ranks between the 3rd and the 4th. It is thus always within the range of unassisted sight at maximum, but it goes down far below that range at minimum, its faintest light bringing it down practically to the 10th magnitude. The "astronomer without a telescope," therefore, can only watch it at its maxima, but these form for Mira Ceti the interesting phase. The other three stars are at all times well within the range of vision. A telescope, therefore, is not needed for them, and it is much better that it should not be used.

The most striking star of the four with which to begin is Algol. The student, avoiding all references to Ephemerides, should look out at regular intervals and compare the brightness of Algol with certain of the neighbouring stars. Ordinarily Alpha Persei will be distinctly but not very greatly brighter than our variable, whilst Gamma, Delta, Espilon and Zeta will be distinctly fainter. At a little greater distance are Alpha and Beta Arietis, the former slightly brighter, the latter slightly fainter than Algol. Alpha and Beta Trianguli are at no great distance, and are good comparison stars when Algol has begun to fade.

It will not be long before the observer will find that his star is undergoing a change, and that it no longer nearly rivals Alpha Persei or Gamma Andromedæ in brightness. Directly this is noticed, systematic observation should be commenced. A star should be chosen, reasonably near, distinctly brighter than the variable, and a second star distinctly fainter. It is usual among variable star observers to estimate these differences in "steps," these "steps" corresponding generally to about a tenth of magnitude, though probably the beginner will make his steps considerably larger than this. The central principle, however, is that two stars should be selected, one of which the observer is clear to be fainter than the variable, and the other brighter, and yet both of them pretty near the variable in brightness. The student should further be careful to record whether the difference between the variable and the fainter star was equal to, greater than or less than the difference between it and the brighter. An observation therefore might run as follows:—

Sep. 1d. 11h. 15m. $2 > a\ 3 < b$

where a and b are the two comparison stars This would mean that at 11h. 15m. the variable was noted to be two "steps" brighter than a and three "steps" fainter than b; in other words that it is slightly nearer an equality with a than with b.

Of course there is no reason why the observer should confine himself to two comparison stars. To begin with, indeed, it is well that he should try more; bearing in mind that the stars should be as nearly as possible at the same altitude, as a marked difference in the height above the horizon will have a considerable effect upon the estimation.

Having made one set of satisfactory observations, the student should leave the star for a while—say for half-an-hour—and then make an entirely fresh set of observations. If he should be fortunate enough to hit upon the commencement of a minimum his second observation will show him the star somewhat fainter than the first, and the difference will become more marked at a third observation. The entire period of decline and recovery for Algol is nine hours, the light fading for 4½ hours, remaining constant for a few minutes, and then gradually increasing again for another period of 4½ hours. The light changes therefore at a most rapid rate at about 2¼ hours before minimum or about the

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same interval afterwards, that is to say when the change is about half completed.

The observation is a simple one, with no accessories of brilliant lights or pleasing colours. Yet the young observer cannot, we think, but experience a real pleasure when for the first time his observations, carefully and systematically made and duly recorded show him beyond a doubt that he is witnessing the dimming of the Demon Star; that he is watching across untold millions of millions of miles of space the signalling of that far distant sun. There will be a sense of achievement, greater and not less because it has been accomplished by his unaided sight, than if he had had the help of some great instrument, and if there be in him anything of the stuff of which astronomers are made, he will turn eagerly to look for other objects of study, and will wait with much interest for other opportunities of watching Algol.

He will not soon exhaust this field of work which Algol has to offer him. Minimum after minimum should be carefully watched so as to determine the period. This of course is now known with the utmost exactness, even to the thousandth part of a second, and the purpose of the student's making an independent determination is for his own training in the work, not for a closer approximation to the true elements of the star. Nevertheless it has been by the continual repetition of such observations, long after the period was precisely known, that minute variations in it have been discovered, and the student should certainly not drop Algol from his observing list until he has been able not only to work out a period for himself, and so to predict in advance future minima, but also to detect an apparent irregularity in the period which is known as "the equation of light," and which is due to the fact that light takes some 16 minutes to cross the orbit of the earth. Minima which are observed in November, therefore, when the earth is at its nearest position to Algol, come earlier than the average; those in March and June come later.

It is of course well known now that the variability of Algol is due to its having a dark companion which revolves round it in about 69 hours. The variation in Beta Lyræ is of a more complicated kind. Here there are two minima, one less pronounced than the other, and we infer therefore that in this case both stars are bright and that they alternately eclipse each other. The variation is less than with Algol, being but little more than a single magnitude.

Delta Cephei has a variation of much the same amount as Beta Lyræ, but it differs from that star in that it has a slow decline and a quick recovery—the decline being 91 hours, the recovery 38.

It is, however, rather with the variables of longer period that the student will most occupy himself, and, therefore, it is especially desirable that the beginner should turn his attention to the last of the four stars which I have named, Mira Ceti, before it again fades into invisibility.

JUPITER AND HIS MARKINGS.

By W. F. DENNING, F.R.A.S.

JUPITER is the most interesting planet of the solar system, considered as a subject for telescopic investigation; and he is certainly one of the easiest objects we have, on account of his large size and the conspicuous character of many of the markings he displays. It is in the study of changes in the figure and motion of these markings that Jupiter offers attractions of a more distinct and special kind than those of any other planet. Venus is beautiful, as a crescent, but her disc shows no more than mere suspicions of dusky areas, of which it is exceedingly difficult to trace the outlines or discern variation. Mars displays an interesting configuration, in reference to which we have still much to learn, but he is of small dimensions, and only visible to the best advantage at comparatively long intervals. Saturn exhibits a novel and picturesque effect, but his details are somewhat faint, and this, combined with his great distance and relatively small apparent diameter, has occasioned a good many dubious observations of late years. No doubt there are occasional irregularities in the belts, and definite spots now and then appear, for there is every reason to believe that the surface phenomena of the planet is somewhat similar to that operating on Jupiter.

In 1878 and 1879, when the great red spot developed into striking prominence and became an attractive object for study, the planet Jupiter was surveyed in nearly every telescope, and our knowledge of his phenomena was much enhanced. It was soon found that the dark belts and bright zones represented a series of different longitudinal currents. The red spot indicated a rotation in 9h. 55m. 34s., the white equatorial spots in about 9h. 50m., while in 1880, some dark spots in the north hemisphere returned in 9h. 48m. Other objects showed proper motions, and the rates seemed to vary with the time. It is true these features were not entirely new, for Cassini, about two centuries before, had seen a white equatorial marking rotating in 9h. 50m., while a great southern spot (possibly identical with the red spot of our own times) moved in 9h. 55m. 58s.

The spots having considerable proper motion and being subject to extensive changes cannot be regarded as material parts of the planet's surface. They are probably situated in the outer envelopes of Jupiter, and do not accurately indicate the true rotation period of the planet's globe. It is probable that the time differs little from 9h. 56m., but it is doubtful to several seconds. In the case of Mars we know the rotation period to the tenth of a second, his principal lineaments being durable surface markings, which have been followed during the two and a half centuries which have elapsed since the times of Huygens and Hooke.

During the last few years Jupiter has received much further investigation. The red spot is still present, though only as a dusky stain in the bay or hollow in the south side of the great southern equatorial belt. The latter feature has certainly been intermittently visible since 1831, September, when Schwabe drew it, and there is every prospect that it will remain visible for many years. In fact, it appears to be an object which, like the red spot, is subject to fluctuations, not only of velocity but of appearance, and is also liable to temporary obliteration. Its mean rate of rotation between 1831, September, and 1899, September, was 9h. 55m. 36.4s. (from 60,074 rotations), while its present rate is about 9h. 55m. 41.7s., but in recent years it has varied as under:—

	h.	m.	s.		h.	m.	s.
1894	9	55	41.0	1897	9	55	41.5
1895	9	55	41.1	1898	9	55	41.6
1896	9	55	41.3	1899	9	55	41.7

The values for the last two years are slightly less than those given in my paper in *Monthly Notices*, Vol. LIX., p. 580, and they are more correct, depending as they

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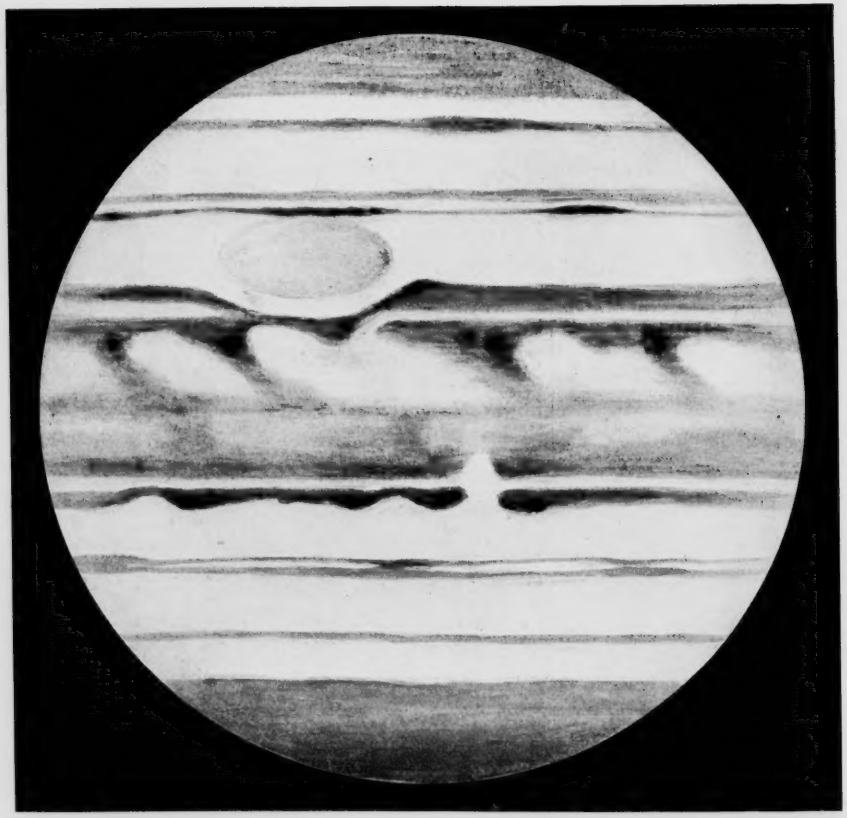
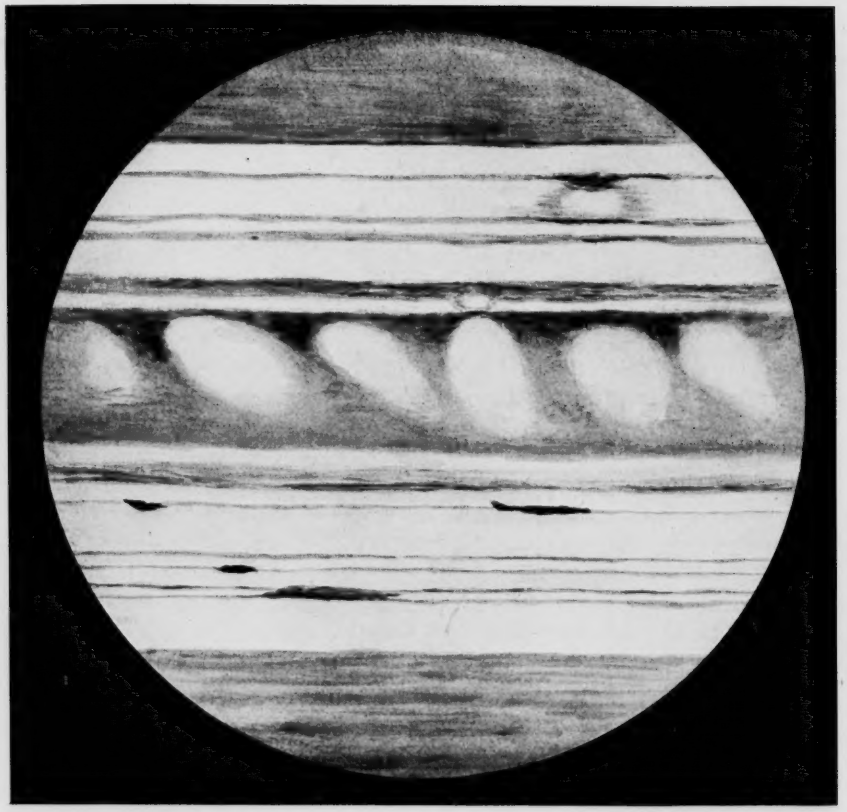


JUPITER.—1899, August 1, about 7h. 50m. 10-in. Reflector, power 312. W.F.D.



JUPITER.—1898, April 22, about 8h. 30m. 10-in. Reflector, power 312. W.F.D.

JUPITER AND HIS MARKINGS.

do upon a later and more complete investigation. There are indications that the spot has now begun to show an accelerated rate, my recent observations being as follows:—

Date. 1899.	Transit. H. M.	Longitude. °	Date. 1900.	Transit. H. M.	Longitude. °
Aug. 30 ...	6 33 ...	37.0	Jan. 8 ...	20 22 ...	36.4
Sept. 6 ...	7 21 ...	36.4	Feb. 6 ...	19 26 ...	37.9
,, 14 ...	3 59 ...	34.7	,, 20 ...	20 59 ...	37.4
,, 16 ...	5 41 ...	36.5	,, 21 ...	16 53 ...	39.0
Dec. 13 ...	18 51 ...	38.2	Mar. 15 ...	15 3 ...	38.7
,, 30 ...	17 54 ...	35.7	,, 17 ...	16 42½ ...	39.5

From thirty-five transits obtained in 1899, and from others secured in 1898, I found that the longitude of the spot was increasing at the rate of 0°.7 per month, and that if this had been continued the marking would now be in 41°.5, whereas its position is about 40°, so that its rotation period this year has very slightly exceeded the rate (9h. 55m. 40.63s.) adopted for system II. of Mr. Crommelin's Ephemerides, published in *Monthly Notices*. The spot now follows the zero meridian about 66 minutes. Its eastern (following) end is darkest, and easily seen, but the entire elliptical outline of the object can only be traced on a really first class night.

There are a large number of equatorial spots visible in the form of irregular white and dark patches which are constantly undergoing changes. In the various years when I have watched such of these markings as border the south side of the Equator, their rotation periods have been as under:—

	h.	m.	s.		h.	m.	s.
1880	9	50	5.8	1886	9	50	22.8
1881	9	50	8.8	1895	9	50	34.3
1882	9	50	11.4	1898	9	50	23.6
1885	9	50	14.3	1899	9	50	24.6

The present period of these objects does not differ materially from the rate exhibited in the two preceding years. I believe that many of these objects have existed for a very lengthy interval. They are probably the same objects as were seen so prominently in 1879, 1880, and following years. Or we may go back further still to the similar appearances figured by Gledhill and others in 1869 and 1870, and even to the equatorial spots delineated by Dawes, Huggins, Lassell, and others, in 1858 and 1859. But there is a difficulty in identifying the objects, as they are very numerous, and a break of a few months has necessarily to occur in the observations every year, Jupiter being invisible near to the sun. At the present time, though the mean rate of the equatorial current is about 9h. 50m. 25s., the individual spots differ in their rates from about 9h. 50m. 15s. to 9h. 50m. 35s.

In the south temperate zone (in which the red spot lies) the spots rotate at a regular rate of 9h. 55m. 19s. I have noticed no change whatever in their motion during the last twenty years, and, consulting old records, I find that they have preserved the same period for a great length of time. This is very curious, in view of the singular variations of rate apparent in other latitudes, and I believe these south temperate markings, like many other features of Jupiter, are of considerable duration. They suffer variations due to the atmospheric vicissitudes under which they exist, but, though temporarily obliterated, reappear in the same positions. There are quite a large number of light and dark spots in about S. latitude 28° or 30°, which have, I believe, been visible during the last twenty years. They move more rapidly than the red spot, and pass that object just on his southern borders. Their conjunctions with the red spot are exceedingly interesting phenomena. In about 1880, when the rotation period of the latter was 9h. 55m. 35s., the conjunctions occurred at intervals of about 920 days, but in about 1898 the period was reduced to 650 days. The interval separating the conjunctions has, however, varied each year in consequence of the marked change of velocity in the rate of the red spot. I have traced back the conjunctions of two south temperate dark spots (nearly all observed) with the red spot approximately as follows:—

I.	II.
1881, December.	1880, July.
1884, April.	1882, December.
1886, May.	1885, February.
1888, April.	1886, November.
1890, February.	1888, September.
1891, December.	1890, August.
1893, September.	1892, June.
1895, July.	1894, April-May.
1897, April.	1896, February.
1899, January.	1897, November.
*1900, October.	1899, August.
*1902, July.	*1901, May.
	*1903, January.

* These are the predicted dates of future conjunctions.

Spot No. I. is at present in longitude 120°, while No. II. is in 203°. There are several other markings of similar character; two of these were in conjunction with the red spot at following times, viz., No. III. 1892, October; 1894, August; 1896, May; 1898, January; 1899, November; and No. IV., 1892, March; 1894, January; 1895, November; 1897, August; 1899, April.

Further south of the south temperate spots the current is more rapid, the rotation period being about 9h. 55m. 7s.

In the north temperate region there is a remarkable diversity in the proper motions of the objects. Here we discover both the shortest and longest periods. In north latitude, about 30°, the spots and condensations in the belts rotate in periods ranging from 9h. 55m. 50s. to 9h. 56m. Yet there is a narrow belt in about latitude 25° N. which in 1880 rotated in 9h. 48m., and in less than 9h. 50m. in 1891. In this belt there appear to be remarkable disturbances at intervals of about ten years. There were outbreaks from it in 1850, 1860, 1870, 1880, and 1890. Some details of these phenomena were described by the writer in the *Monthly Notices* for December, 1898. It is highly probable that another eruption of spots will take place from the same belt at the close of 1900, and be observed when Jupiter becomes a morning star in February, 1901. Telescopic observers should therefore carefully observe the planet at this time with a view to detect the recurrence of the phenomenon.

In the N. tropical zone of Jupiter, and bordering the N. edge of the northern equatorial belt, we find another seat of very active and long continued energy. White and dark spots are plentifully distributed along the edge of the belt, and they do not partake in the rapid velocity of the equatorial current, their period being about 9h. 55m. 33s., though it varies to the extent of a few seconds in different years. In 1899, the individual markings differed in their periods to the extent of 18 seconds, and it was clearly manifested by all the observations that one section of the belt, between longitude 140° and 260°, was moving much more rapidly than the other part (*see* Rev. T. E. R. Phillip's valuable chart in *Monthly Notices*, Vol. LX., p. 214).

The time seems come when all observations of Jupiter made at each opposition of the planet should be com-

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bined and discussed according to approved methods The greater the number of observations the nearer the approach will be to accuracy. So many observers now occupy themselves with these observations that individual deductions, as regards rotation periods, had better be discontinued in favour of a collective effort to ensure safe and certain results. The plan of reduction initiated by Mr. Marth, and followed by Mr. A. S. Williams, Rev. T. E. R. Phillips, and others, is to be greatly commended, and there seems little doubt that in future years it will be generally adopted, and be the means of vastly increasing our knowledge of the surface vagaries of this wonderful planet.

In the drawings of Jupiter accompanying this paper no attempt has been made to show the slight curvature of the belts due to the inclination of the planet in 1898 and 1899.

[It should be noted that this paper was written in April, 1900.—EDS.]

THE HUNDRED BRIGHTEST STARS.

By J. E. GORE, F.R.A.S.

WE sometimes hear of "the Hundred Best Books," and there is much difference of opinion as to what these books are. But there can be little or no doubt as to the hundred brightest stars in the heavens, although the exact order of their arrangement—or sequence, as it is termed—may be somewhat uncertain. In the following table I have arranged the hundred brightest stars in the sky in the order of magnitude as measured with the meridian photometer at Harvard College Observatory (U.S.A.), and at Arequipa, Peru. For the stars visible in the Northern hemisphere the results are given in the "Harvard Photometry" (H.P.), and in the Revision of the same recently published, and for the Southern stars in the "Southern Meridian Photometry" (S.M.P.). When a southern star occurs in all three catalogues I have taken the magnitude given in the S.M.P., as the observations were evidently made under more favourable conditions. I have also given the magnitude of each star as measured with the wedge photometer at Oxford, and also in the Potsdam photometric catalogues (recently published) whenever the star is found in these catalogues. To make these catalogues strictly comparable it should be noted that the standard star Polaris is 2.15 magnitude in the H.P. and S.M.P. catalogues, 2.05 in the Oxford, and 2.34 in the Potsdam catalogue. The spectrum of the star's light is given from the "Draper Catalogue of Stellar Spectra," when the star is found in that catalogue, I. denoting the Sirian type, II. the solar type, and III. the third type Some are given from the Harvard Annals, Vol. XXVIII., Part I., and a few from other sources. I have also added the star's parallax and proper motion where these have been determined. I have placed the stars in order of brightness according to the H.P., as in that catalogue the comparison star was Polaris, a comparatively bright star, while in the Revision of the H.P. the comparison was λ Ursæ Minoris, a faint star (6.57).

The position of the stars are given for 1900.0, and the list may be useful to variable star observers as affording comparison stars for naked eye stars suspected of variation in light.

No.	Star.	R.A. 1900.0.	Dec. 1900.0.	Photometric Magnitudes.				Spectrum.	Parallax.	Proper Motion.
				H.P.	Revision of H.P.	Oxford.	Potsdam.			
		H. M.	° ′						″	″
1	Sirius	6 40.7	S. 16 34	−1·43	−1·67	−0·95	—	I. (A?)	0·39	1·32
2	Canopus	6 21.8	S. 52 39	−0·96	—	—	—	II.	0·03	
3	Arcturus	14 11.1	N. 19 44	0·03	0·07	0·31	0·27	II. (K)	0·018	2·28
4	Capella	5 9.3	N. 45 54	0·18	0·24	0·08	—	II. (F)	0·107	0·43
5	Vega	18 33.6	N. 38 41	0·19	0·10	0·14	0·41	I. (A)	0·034	0·36
6	α Centauri	14 39.8	S. 60 25	0·20	—	—	—	II. (G)	0·76	3·62
7	Rigel (α Orionis)	5 9.7	S. 8 19	0·32	0·28	−0·03	—	II. (F)		
8	Procyon	7 34.1	N. 5 30	0·46	0·47	0·50	0·75	II. (F)	0·27	1·26
9	α Eridani	1 34	S. 57 44	0·51	—	—	—	I. (B)		
10	β Centauri	13 56.7	S. 59 53	0·83	—	—	—	I. (B)	0·018	
11	α Orionis	5 49.8	N. 7 23	0·91	0·94	0·98	—	III.	0·009	
12	Altair (α Aquilæ)	19 45.9	N. 8 36	0·97	0·74	1·04	1·15	I. (A)	0·20	0·64
13	Aldebaran	4 30.2	N. 16 19	1·00	1·07	1·12	1·18	II. (K?)	0·15	0·19
14	α Crucis	12 21.1	S. 62 32	1·02	—	—	—	I. (B)		
15	Antares	16 23.2	S. 26 13	1·06	1·44	1·13	—	III.		
16	Pollux (β Gemini)	7 39.2	N. 28 16	1·12	1·25	1·36	1·54	II. (K?)	0·068	
17	Spica (α Virginis)	13 19.9	S. 10 38	1·23	1·09	0·96 0·81	—	"Orion type"	Negative	
18	α Pis. Aust.	22 52.1	S. 30 9	1·27	1·31	—	—	I.		
19	Regulus (α Leonis)	10 3.1	N. 12 28	1·42	1·34	1·17	1·76	I (A)	0·093	
20	α Cygni	20 38.0	N. 44 56	1·47	1·25	1·32	—	I. (A)	Negative	
21	ε Can. Maj.	6 54.7	S. 28 50	1·49	1·65	—	—	I. (A?)		
22	β Crucis	12 41.8	S. 59 8	1·49	—	—	—	I. (B)		
23	γ Crucis	12 25.6	S. 56 33	1·55	—	—	—	III.		
24	Castor (α Gem)	7 28.2	N. 32 7	1·56	1·61	1·53	1·97	I. (A)	0·198	
25	β Argûs	9 12.1	S. 69 18	1·73	—	—	—	I. (A)		
26	ε Argûs	8 20.4	S. 59 11	1·74	—	—	—	II. (K)		
27	ε Orionis	5 31.2	S. 1 16	1·76	1·74	—	—	I. (A)		
28	λ Scorpii	17 26.8	S. 37 2	1·79	1·79	—	—	I. (B)		
29	δ Can. Maj.	7 4.3	S. 26 14	1·85	2·16	—	—	II. (G?)		
30	ε Ursæ Maj.	12 49.6	N. 56 30	1·85	1·76	1·80	—	I. (A)	0·030	
31	γ Orionis	5 19.7	N. 6 16	1·86	1·59	1·79	2·06	I. (B)		
32	ζ Orionis	5 35.8	S. 2 0	1·89	1·89	1·80	—	I. (A)		
33	α Trian. Aust.	16 38	S. 68 51	1·89	—	—	—	II. (K)		
34	β Tauri	5 20.0	N. 28 32	1·90	1·66	1·79	2·02	I. (A)		

No.	Star.	R.A. 1900.0.	Dec. 1900.0.	Photometric Magnitudes.				Spectrum.	Parallax.	Proper Motion.
				H.P.	Revision of H.P.	Oxford.	Potsdam.			
		H. M.	° ′						″	″
35	γ Argûs	8 6.5	S. 47 2	1·91	2·37	—	—	Bright lines		
36	α Gruis	22 1.9	S. 47 27	1·92	2·10	—	—	I. (A)		
37	ε Sagittarii	18 17.5	S. 34 26	1·93	1·81	—	—	I. (A)		
38	α Persei	3 17.1	N. 49 30	1·94	1·85	1·93	—	II. (F)		
39	α Ursæ Maj.	10 57.6	N. 62 18	1·96	1·93	1·89	—	II. (K)	1·22 (?)	
40	θ Scorpii	17 30.1	S. 42 56	1·99	2·08	—	—	II. (F)		
41	γ Geminorum	6 31.9	N. 16 29	2·00	1·88	2·13	2·34	I. (A)		
42	δ Velorum	8 42.0	S. 54 20	2·00	—	—	—	I. (A)		
43	β Can. Maj.	6 18.3	S. 17 55	2·01	1·97	—	—	I. (B)		
44	α Hydræ	9 22.7	S. 8 14	2·02	2·29	2·22	—	II. (K)		
45	η Ursæ Maj.	13 43.6	N. 49 49	2·02	1·88	1·77	—	I. (A)	0·095	
46	α Arietis	2 1.5	N. 23 0	2·04	2·19	2·13	2·22	II. (K)		
47	α Pavonis	20 17.7	S. 57 3	2·05	—	—	—	I. (B)		
48	β Aurigæ	5 52.2	N. 44 56	2·07	1·98	1·94	—	I. (A)		
49	α Andromedæ	0 3.2	N. 28 33	2·08	2·09	2·05	2·44	I. (A)		
50	β Gruis	22 36.7	S. 47 24	2·09	2·14	—	—	III.		
51	λ Argûs	9 4.3	S. 43 2	2·10	2·37	—	—	K—M		
52	β Ceti	0 38.5	S. 18 32	2·13	2·35	2·42	—	II. (K)		
53	β Ursæ Min.	14 51.0	N. 74 34	2·13	2·31	2 26	—	II. (L?)	Negative	
54	γ Andromedæ	1 57·7	N. 41 51	2·14	2·26	2·14	—	II.		
55	α Ursæ Min. (Polaris)	1 22.0	N. 88 46	2·15	2·20	2·05	2 34	II. (F?)	0·07	0·05
56	α Ophiuchi	17 30.3	N. 12 38	2·18	2·10	2·23	2·54	I (A)	1·57 (?)	
57	θ Centauri	14 0.8	S. 35 53	2·19	2·34	—	—	II. (K)		
58	β Andromedæ	1 4.1	N. 35 5	2·21	2·17	2·21	2·33	III.		
59	κ Orionis	5 43.0	S. 9 42	2·22	2·20	2·42	—	I. (A)		
60	β Leonis	11 44.0	N. 15 8	2·23	2·28	2·07	2·62	I. (A)		
61	ι Argûs	9 14.4	S. 58 51	2·24	—	—	—	II. (F)		
62	γ Leonis	10 14.4	N. 20 21	2·24	2 35	2·12	2·45	II. (K)		
63	α Cassiopeiæ	0 34.8	N. 56 0	2·25	2·47	2·41	—	II. (K)	0·036	
64	ε Scorpii	16 43.8	S. 34 7	2·29	2 44	—	—	II. (K)		
65	γ Cassiopeiæ	0 50.7	N. 60 10	2·30	2·23	2·19	—	"Orion type"	0·05 (?)	
66	σ Sagittarii	18 49.1	S. 26 25	2·30	2·02	—	—	"Orion type"		
67	γ Cygni	20 18.6	N. 39 56	2·31	2·33	2 26	2 50	II. (G)		
68	β Persei (Algol)	3 1.6	N. 40 34	2·31	—	2·40	—	I. (A)	0 07 (?)	
69	ζ Argûs	8 0.1	S. 39 43	2·33	2·36	—	—	Bright lines		
70	γ Draconis	17 54.3	N. 51 30	2·35	2·48	2·40	—	II. (K)	Negative	
71	γ Centauri	12 36.0	S. 48 24	2 36	—	—	—	I. (A)		
72	δ Orionis	5 26.9	S. 0 22	2 36	2·59	2·02	—	"Orion type"		
73	α Coronæ	15 30.6	N. 27 3	2·37	2·25	2·23	2·60	I. (A)		
74	ζ Ursæ Maj.	13 19.9	N. 55 26	2·38	2 18	2·09	—	I. (A)	0·045	
75	η Can. Maj.	7 20.2	S. 29 6	2·41	2·50	—	—	"Orion type"		
76	ε Pegasi	21 39.2	N. 9 25	2·41	2·67	2·43	2·76	II. (K)		
77	β Cassiopeiæ	0 3.8	N. 58 36	2·42	2·44	2·32	—	II. (F)	0·162	0·57
78	α Phœnicis	0 21.3	S. 42 51	2·45	2·40	—	—	?		
79	α Lupi	14 35 2	S. 46 58	2·46	3·33	—	—	I. (B)		
80	π Argûs	7 13.6	S. 36 55	2·49	2·92	—	—	?		
81	δ Scorpii	15 54 4	S. 22 20	2 52	2·49	—	—	"Orion type"		
82	η Centauri	14 29.2	S. 41 43	2·54	2·84	—	—	F line bright		
83	ε Boötis	14 40.6	N. 27 30	2·56	2·62	2·47	2 68	II.		
84	β Pegasi	22 58.9	N. 27 32	2·56	2·76	2·50	—	III. (M?)		
85	γ Ursæ Maj.	11 48.6	N. 54 15	2·56	2·53	2·30	—	I. (A)	0·017	
86	ε Centauri	13 33.6	S. 52 58	2·58	—	—	—	I. (B)		
87	α Cephei	21 16.2	N. 62 10	2·58	2·63	2·57	—	I. (A)	0·061	
88	κ Scorpii	17 35.5	S. 38 59	2·59	2·60	—	—	I. (B)		
89	κ Velorum	9 19.0	S. 54 35	2·59	—	—	—	I. (B)		
90	β Ursæ Maj.	10 55.9	N. 56 55	2·60	2·57	2·17	—	I. (A)	0·011	
91	α Pegasi	22 59.8	N. 14 41	2·61	2·61	2·33	3·20	I. (A)		
92	η Ophiuchi	17 4.6	S. 15 36	2·62	2·60	2·42	—	I. (A)		
93	θ Aurigæ	5 52.9	N. 37 13	2·67	2·70	3 03	2·88	I. (A)		
94	α Leporis	5 28.3	S. 17 54	2·67	2·73	—	—	I.		
95	α Ceti	2 57.1	N. 3 42	2·68	2·84	2·44	2 89	III.		
96	ε Cygni	20 42 1	N. 33 35	2·69	2·58	2·45	2·74	II. (K)		
97	δ Sagittarii	18 14.6	S. 29 53	2·69	2·98	—	—			
98	ζ Sagittarii	18 56.3	S. 30 1	2·69	2·79	—	—			
99	α Serpentis	15 39.3	N. 6 44	2·71	2 79	2·67	2·88	II. (K?)		
100	β Aræ	17 17.0	S. 55 27	2·72	—	—	—	II. (K)		
(101	ι Aurigæ	4 50.4	N. 33 0	2·72	2·99	2·87	2·86	II. (K))		

NOTES ON THE ABOVE LIST.

2. A very brilliant star which does rise above the horizon of London. Spectrum "early solar type" according to Huggins.

3. Sir William Herschel found Arcturus considerably brighter than Vega.

11. This star is variable to the extent of about half a magnitude.

13. This is generally considered as a standard star of the first magnitude. But it has been suspected of variation.

14. This is the brightest star in the Southern Cross.

15. The spectrum of this star is said to be "composite."

22. One of the stars in the Southern Cross.

23. Spectrum according to Ellery.

35. This star was estimated 3.0 at Cordoba, and may possibly be variable. Sir John Herschel made it 2.11.

44. This star is red and a suspected variable.

50. Spectrum according to Pechüle.

53. This star has been suspected of variation.

54. Spectrum said to be "composite."

55. This is the standard star of the photometric catalogues, except the Revision of the H.P., in which the comparison star is λ Ursæ Minoris, magnitude 6·57.

60. A suspected variable star. It was rated of the first magnitude by Al-Sufi in the 10th century.

63. This star is a variable, but has no regular period. The variation is from about 2.2 to 2.8, so that when at its minimum light, it is not among the hundred brightest stars.

66. The famous variable star. The variation is from 2.3 to 3.5, so that at minimum it retires for a few hours from the list of "hundred brightest stars."

72. A suspected variable star.

73. A suspected variable star.

76. A suspected variable star.

79. There is considerable difference of magnitude between the H.P. and the Revision of the H.P. The star was estimated 2.6. at Cordoba.

82. Spectrum with hydrogen F line bright according to Bailey.

83. The spectrum is said to be "composite."

84. A known variable star which varies from about 2.2 to 2.7, but with no regular period.

91. Allowing for difference of scale there is considerable discrepancy between the Oxford and Potsdam measures which suggests possible variation of light.

The lowest magnitude given in the list is 2.72. The following stars are brighter than this in the Revision of the Harvard Photometry:—

	h.	m	°	′			
α Columbæ	5	36·0	S. 34	8	2·55	S.M.P.	2·74
δ Leonis	11	8·8	N. 21	4	2·68	H.P.	2·75
β Lupi	14	52·0	S. 42	44	2·68	S.M.P.	2·74
β Libræ	15	11·6	S. 9	1	2·66	H.P.	2·74
β Scorpii	15	59·6	S. 19	31	2·70	H.P.	2·91
ζ Ophiuchi	16	31·7	S. 10	22	2·64	H.P.	2·84

Of the hundred stars in the list, 47 are north of the Equator and 53 south, so that the 100 brightest stars are pretty equally distributed in each hemisphere, with a slight preponderance in favour of the southern hemisphere.

I find that of the 100 stars in the list, no less than 58 lie in or near the Milky Way, a remarkable fact considering that the Galaxy does not—at most—cover more than one-fourth of the area of the star sphere.

With reference to spectra, there are 51 of the I. type (including those of the "Orion type"), 34 of II. type, and 7 of type III. Of the stars lying in or near the Milky Way, there are 32 of type I., and 19 of type II. This shows a marked preponderance of bright Sirian stars in the Galaxy.

It is, I think, a popular idea that the stars forming the Southern Cross are some of the very brightest in the heavens, but this is quite a mistake, as the brightest of them, α Crucis, is only 14th in the above list, the next, β Crucis, is No. 22, the next, γ Crucis, is No. 23, while the fourth star, δ Crucis, is not included in the first hundred brightest stars, its magnitude being only 3·08.

Letters.

[The Editors do not hold themselves responsible for the opinions or statements of correspondents.]

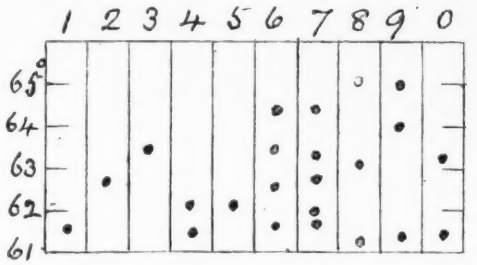
HOT AND DRY SUMMERS.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—Distinguishing each of the last 60 summers at Greenwich as either hot or cool, or as dry or wet (by relation to the averages), it may not be too obvious to remark that hot summers are not all dry, nor cool summers all wet. The following classification shows this:—

Hot and dry summers	23
Cool and wet...	19
Cool and dry...	12
Hot and wet...	6
	60

Let us arrange these 23 hot and dry summers in ten groups, according to their position in a decade; those of years ending in 1 together, those of years ending in 2 together, and so on; and represent each summer by a dot at level corresponding to the temperature. (The rainfall relation is not indicated in each case; it will be understood that all those summers had less rain than the average.)



Hot and Dry Summers.

In this rough diagram we might note the following among other points:—

1. The five hottest dry summers (64° and over) are all in the years ending 6 to 9.

2. Of ten summers over 63°, nine are in the decade half 6 to 0; and only one in the other half, 1 to 5.

3. The years ending 6, 7, and 8 have four times as many hot dry summers as those ending 1, 2, and 3 (12 to 3).

4. The summers of years ending in 7, are all hot and dry except one (1867).

These facts might perhaps be found useful in forecasting. ALEX. B. MACDOWALL.

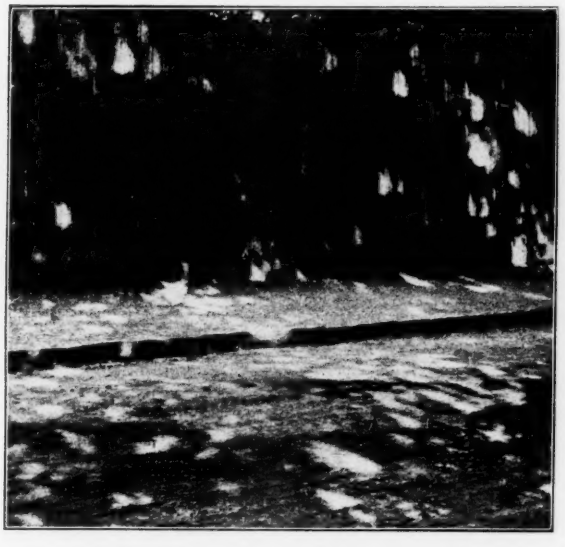
CRESCENT-SHAPED IMAGES OF THE SUN DURING THE ECLIPSE.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—If you look under a tree when the sun is shining you will see that where the sun finds its way through the branches all the *small* spots of sunshine on the ground are of a circular or oval shape. This is due to the fact that the interstices between the leaves act like the lens in a camera obscura, or perhaps to be more accurate, they may be said to act like the pinhole in the front of a pinhole camera, and they therefore really project small images of the sun on the ground.

The curious thing is that whatever the shape of the

interstices between the leaves, provided only that they are small, the spot of light on the ground is always of a round or oval shape. Our photographic readers will remember that the same thing is noticed with the stops of their lenses, whether the aperture of the stop is round, oval, or square, the image on the ground glass is the same. Of course to get the spots of light on the ground quite circular the surface of the ground must be at right angles to the ray of sunshine which finds its way through the leaves. In this country, however, the sun is never vertical, so the sun images are



Crescent-shaped Images of the Sun during the Eclipse.

generally of an oval shape, except only in the rare cases where the ground happens to slope in such a manner that the sun's rays strike it at right angles.

During an eclipse the images of the sun assume the crescent shape of the sun itself, and in the accompanying photograph, taken on May 28th last, a number of spots of a crescent shape will be seen on the fence and on the road. The large irregularly shaped patches of sunlight are cases in which the sun has been shining through spaces too large to act as a "pinhole-lens," or where images from several apertures have fallen over one another. E. PIERCE.

"Claremont," Balfour Rd.,
South Norwood.

ASTROLOGY.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—I should like to appeal against the antipathy which appears to exist against those doctrines usually termed astrological.

The majority of astronomers, without the least examination of the subject, reject the idea of planetary influence as being totally unworthy of their consideration, completely ignoring the fact that there are hundreds of proofs in its favour.

No modern scientist would think of denying that between the sun and the planets, and the planets and each other, there is a mysterious connection, akin to electricity, which manifests itself in gravitation, centripetal attraction, and perturbations of their orbits. Why, therefore, should not this mutual influence show itself, psychically, so to speak, in the destinies and characters of a planet's inhabitants?

Pythagoras, whom we have every reason to believe originated the modern system of astronomy, was undoubtedly a believer in astrology, and the famous Kepler was also an adherent to its teachings.

I wish that some of your readers would give the matter a sound and unbiased investigation which would prove whether the Egyptians, the Chaldeans, and other highly-civilised races were wrong in the opinions they entertained for many thousands of years.

240, Holloway Road, N. B. CHATLEY.

[In reply to Mr. Chatley it is sufficient to say that astronomers do not care to waste time on an examination into astrology, for the reason that there is nothing in it to examine. It is simply a gross imposture, a special form of Fetichism, *i.e.*, of the arbitrary ascription to inanimate objects of mysterious powers, entirely apart from any physical and material action. The only excuse it ever had was in the days of bygone heathendom, when the sun, moon, and planets were looked upon, not as things, but as beings: as Gods, in fact, and were worshipped as such.

But as compared with the English astrologer, the West African negro shows himself much the more reasonable and intelligent. The latter, if his fetich does not bring him the expected good luck, will kick or beat it, and consign it to the dust-heap. The former, if Venus and Mercury do not justify his anticipations, does not dream of reconsidering his notions as to their "influences," but goes on still blindly believing in spite of the clearest evidences against him.

Present day astrologers can neither tell when or how the special "influences" supposed to reside in each individual "planet" or "house" were determined, nor give the observations upon which primitive astrology was based? They choose to call Jupiter "fortunate" and Saturn "malign"; but if anyone should think fit to reverse the attributes, who could contradict him?

Mr. Chatley asks "whether the Egyptians, the Chaldeans, and other highly-civilised races were wrong in the opinions they entertained for many thousands of years." If modern astrologers are right, they certainly were. For the ancients recognised but seven planets, whereas there are—according to modern astrologers—nine. That is to say, in the opinion of the ancients Uranus and Neptune had no influence, for they never detected anything wrong in their calculations, as they should have done if these planets were really potent.

By-the-bye, if these two new planets have any astrological power upon the characters and fortunes of men, how is it that astrologers did not discover them centuries ago? The astronomers had to wait till sufficiently powerful telescopes had been constructed; the astrologers had their materials for study—nations, cities, and individual men, all ready to their hands.

Again, when Uranus and Neptune had been discovered, from what observations, and by what process of reasoning were their specific influences defined?

Further, can astrologers tell us now, by the "outstanding differences" between their predictions and their fulfilments, whether there are more planets to be discovered, beyond Neptune or within the orbit of Mercury?

One point more, the force of gravitation,—to which Mr. Chatley alludes,—varies directly as the mass of the attracting body, and inversely as the square of the

distance. Is it so with the "astrological" or "psychical" force of the planets? Does any astrologer know? If it does not vary according to the same law, does it vary at all for any given planet, or is it always the same for the same body whatever its distance, and equal for all the planets whatever their mass? Or if there be any differences, what is the law governing them? No astrologer can tell; yet without such knowledge astrology stands a fraud self confessed.

[E. WALTER MAUNDER.]

MIRA CETI.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—The usual diligence did not always permit as satisfactory observations of Mira at its last appearance but they were begun earlier and continued later, and altogether may be regarded as a fair exhibit of the star's movement.

O CETI MAXIMUM.

1899.	Mag.	1899.	Mag.
July 19. ...	7·10	Oct. 21. ...	5·18
„ 31. ...	5·02	„ 22. ...	5·45
Aug. 3. ...	5·02	„ 22. ...	5·31
„ 6. ...	4·92	„ 23, 24, 25...	5·47
„ 10. ...	4·37	„ 26. ...	5·12
„ 12. ...	4·42	„ 28, 29. ...	5·33
„ 20. ...	4·26	„ 31. ...	5·28
„ 21. ...	4·37	Nov. 3. ...	5·38
„ 22. ...	4·41	„ 5. ...	5·41
„ 22. ...	4·45	„ 8. ...	5·67
„ 24. ...	4·47	„ 9. ...	5·73
„ 31. ...	4·37	„ 10. ...	6·20
Sept. 2. ...	4·68	„ 22. ...	6·13
„ 3. ...	4·85	„ 23. ...	6·65
„ 6. ...	4·95	„ 28. ...	6·95
„ 7. ...	4·75	„ 29. ...	6·91
„ 11. ...	5·07	„ 30. ...	6·93
„ 13, 15. ...	5·02	Dec. 1. ...	7·00
„ 19. ...	4·85	„ 2. ...	7·00
„ 21. ...	4·00	„ 3, 4. ...	6·85
„ 23. ...	4·45	„ 5, 6. ...	7·15
„ 24. ...	4·00	„ 11. ...	7·50
„ 25. ...	4·25	„ 21. ...	7·91
„ 26. ...	4·51	„ 25, 26. ...	7·95
„ 27. ...	4·61	„ 28. ...	7·97
„ 29. ...	4·86	„ 29. ...	8·10
„ 30. ...	4·92	1900.	
Oct. 1. ...	4·29	Jan. 1. ...	8·00
„ 2. ...	4·41	„ 2. ...	7·97
„ 3. ...	4·92	„ 3. ...	7·92
„ 4. ...	4·97	„ 4. ...	7·87
„ 5. ...	5·02	„ 14. ...	8·50
„ 7. ...	4·91	„ 20. ...	8·60
„ 8. ...	5·07	„ 21. ...	8·62
„ 12. ...	5·28	„ 22. ...	8·52
„ 13. ...	5·29	„ 23. ...	8·60
„ 15. ...	4·95	„ 25. ...	8·60
„ 16. ...	5·00	„ 31. ...	8·75
„ 18. ...	4·97	Lost for the Season.	
„ 20. ...	5·02		

The computed maximum was due September 3rd, but it cannot be definitely placed, though I incline to say 20th August. Minimum due 11th April was apparently not so far off at close of these observations. A difference of 2.5 magnitudes nearly between this maximum and the previous one will not escape remark.

Memphis, Tenn., U.S.A., DAVID FLANERY.
20th April, 1900.

THE HYPOTHETICAL PLANET.

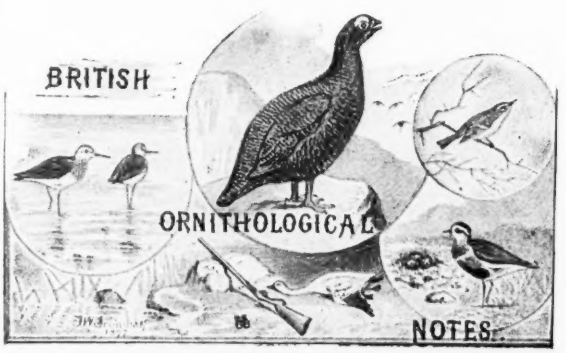
TO THE EDITORS OF KNOWLEDGE.

SIRS,—I have read with much interest Mr. Denning's letter contained in KNOWLEDGE for June, and I agree with him in all particulars. It is practically certain that if there is a planet revolving within the orbit of Mercury it has never yet been detected as such. No one disputes the irregularities of the movements of Mercury, but that any observer with any pretensions to astronomy should claim to have *seen* an intra-Mercurial planet in the act of transit, is, in my humble opinion, either wanting in good faith, or lacking in the qualifications of good sight and experience.

Some observers are apt to forget that, besides having an apparent motion, sun-spots have also a proper motion, and with all due respect to the memory of so capable an observer as Webb, he seems to me to have easily fallen a prey to this rut, and unconsciously mistaken sun-spots with proper motions for bodies revolving inside the orbit of Mercury. "Vulcan" has yet to be seen, not by *one* observer, but by many, since it is hard to think that it would escape the vigilance of so many experienced astronomers dotted all over the globe, who daily make it their practice to look out for any strange phenomenon in or near the sun's immediate neighbourhood.

G. MCKENZIE KNIGET.

Vale View, Barrells Down,
Bishop's Stortford.



Conducted by HARRY F. WITHERBY, F.Z.S., M.B.O.U.

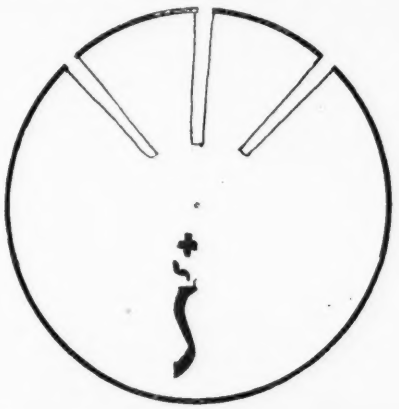
GOLDEN ORIOLES IN DEVON.—At least one pair (I say "*at least* one pair," because the birds have been seen in places so far apart that I suspect there *may* be more than one pair) of "Golden Orioles" has been seen here at intervals for the last two or three years; but whether the birds breed in the neighbourhood or not I cannot say, but I have seen them in the months of June and July. I know the birds by sight, having seen a pair which used to build at Beaulieu Abbey, Lord H. Scott's place in Hampshire. I will ask you not to publish the name of the locality for fear the birds might be shot.—ARNOLD D. TAYLOR, Devon, August 3, 1900.

The Melodious Warbler (Hypolais polyglotta) in Sussex. (*The Ibis*, July, 1900, p. 569.) Mr. W. Ruskin Butterfield, in a letter to the *Ibis*, records that a bird of this species was obtained on May 11th, 1900, at Ninfield, Sussex. The bird has been examined by Mr. Hartert, as well as by Mr. Howard Saunders, who confirm Mr. Butterfield's identification. This is only the second time that the bird has been positively identified as occurring in this country, although it has no doubt often occurred and been overlooked. The first specimen was also obtained in Sussex (*see* KNOWLEDGE, November, 1897, p. 257).

The Natural History of the Ruff. By Charles J. Patten, B.A., M.D. (*Irish Naturalist*, August, 1900, pp 187—209.) This is an exhaustive account of the occurrences and distribution of the Ruff in Ireland. Mr Patten also includes interesting details of the plumages and habits of the bird.

PRODUCTION OF COLOUR EFFECTS.

A VERY singular experiment illustrating the production of colour effects by means of alternate after-images of black and white, has been devised by Mr. C. E. Benham, of Colchester. It is an extremely simple application of the principle of his already well-known artificial spectrum top, in combination with a wheel of life arrangement. To see the effect a circular piece of card has three slits cut in it. These slits radiate from the centre, and for the best effect should be within a quarter segment of the circle, and the width of the slits should not exceed the width of the pupil of the eye. Opposite the central slit a black line, dots, crosses, or in fact any other design in black, is traced. The whole of the back of the card is also blacked. The most perfect dead black for this purpose is made by mixing equal parts of methylated spirit and French polish with



some vegetable black. The disc is supported on a pin passed through the centre and revolved in *a strong light* in front of a mirror, the blackened side being towards the eye. On looking through the slits at the image in the mirror, the line, dots, or other design traced on the face will be seen threefold, and the three images will be seen to be coloured. The colours differ with different people, and with different rates of rotation, but in general the effect is red (the lowest), green, and dark blue, when the disc revolves from left to right; and dark blue (the lowest), green, and red, when the disc revolves from right to left. Colours are also seen with other dispositions of the slits, and also when there are only two, or when there are more than three, though it will be found that the arrangement described gives the most brilliant effects. The more slits, the slower must be the rate of revolution, and *vice versâ*. With only one slit there is of course only a single image, apparently stationary, and uncoloured. Two slits give two images, generally red and dark blue, and changing places as to their colour when the direction of rotation is reversed.

EROS AND THE ASTROGRAPHIC CONFERENCE.

FOR the fourth time the International Permanent Committee met at Paris on July 19, to discuss the future proceedings of the Astrographic Catalogue and Chart. Of the eighteen observatories which gave promise of support at the inception of the Astrographic Chart, three have not been able to fulfil their promises. These observatories, of the mutable South American Republics of Rio Janeiro, La Plata and Santiago (Chile), it is proposed to replace in the scheme by those of Perth (West Australia), Cordoba, and Monte Video. The moot questions of the publication of rectilinear co-ordinates with plate constants, or R.A. and declination of stars; of the measuring the diameters of stars by *scale* or by measuring screw; of giving a single exposure of 40 minutes or three exposures of 30 minutes each to the second series of chart plates; were still left to the several Directors of the eighteen observers to decide as it pleased them individually. Neither was it decided whether the chart plates should be reproduced by heliogravure, as is being done by the Paris Observatory, or by some less expensive method. For the moment it was resolved that copies should be made, but the method of so doing was not decided upon.

But a special committee was also appointed to take charge of the planet Eros during its approaching opposition. This committee consisted of the President, M. Lœwy, and of MM. André (Lyons), Bakhuyzen (Leyden), Christie (Greenwich), Elkin (Newhaven, U.S.A.), Gill (Cape of Good Hope), Hartwig (Bamberg), Prosper Henry (Paris), Trépied (Algiers), and Weiss (Vienna), and they submitted the following resolutions to the general Conference:—

(I.) It is desirable that the determination of the parallax of the planet Eros should be made by micrometric, by heliometric, and by photographic measures.

(*a*) By means of observations of the planet made when in the east and in the west of the same observatory;

(*b*) By the co-operation of the observatories of Europe and North America;

(*c*) By the co-operation of the observatories in the northern and southern hemispheres.

(II.) During the periods of observations of parallax, the daily motion of Eros should be determined as exactly as possible by micrometric, heliometric, and photographic measures.

(III.) The Committee recommend to observers of (*a*) and (*b*) that they should make measures on every morning and evening available, and to profit by the favourable atmospheric conditions to operate through as large hour angles as possible—this will diminish the error from the uncertainty of the planet's motion, and (*c*) that the mean times of observation should not greatly differ from the time of meridian passage of the planet at the southern station.

(IV.) It is necessary to take a special series of photographic plates of the regions surrounding Eros so as to determine the places of the comparison stars.

M. Hartwig will draw up a programme for heliometer observations of the planet; MM. André and Prosper Henry undertake to make researches on the atmospheric dispersion; and MM. Lœwy, Brown (Washington), and Bakhuyzen will undertake the task of executing resolutions concerning micrometric and photographic resolutions.

The observatories taking part are Algiers, Athens, Bamberg, Bordeaux, Cambridge (England), Cambridge (U.S.A.), Cape of Good Hope, Catania, Cordoba, Chicago (Yerkes), Edinburgh, Greenwich, Heidelberg, Leyden, Leipzig, Lyons, Marseilles, Minneapolis (U.S.A.), Mount Hamilton, Nice, Paris, Potsdam, Rome (Roman College), San Fernando, Strasbourg, Tacubaya, Toulouse, Upsala, Vienna (Ottakring), Vienne (Währing), and Washington.

XUM

Notices of Books.

THE SCIENTIFIC RESULTS OF DR. NANSEN'S EXPEDITION.

"THE NORWEGIAN NORTH POLAR EXPEDITION, 1893-1896. Scientific Results." Edited by Fridtjof Nansen. Vol. I. (Longmans.) A popular narrative of Dr. Nansen's famous expedition has been published, as is well known, in many editions and in many languages. Considering the great interest taken in the expedition and its results all over the world it is no small compliment which the explorer pays to the British nation in deciding to publish the scientific results only in the English language. The volume under review contains five memoirs, which are noticed below under their separate titles. We are promised four or five more volumes, which will appear from time to time, the whole work being completed in about two years' time. In order to place the various memoirs before the scientific world at the earliest possible date, they are printed as they are finished, without regard to systematic sequence. And as each memoir is paged separately and is given a number, we cannot see that the plan will lead to any confusion. In the preface to the present volume, Dr. Nansen pays a high tribute to his companions on board the "Fram," and we would add that Dr. Nansen and his companions are indeed deserving of the highest praise in bringing home such abundant and valuable scientific materials in the face of many obstacles. Not only had the ordinary difficulties of Arctic travel to be contended with, but owing to the necessarily small size of the "Fram" in proportion to the amount of provisions, coal, and equipment she had to carry, no room could be found for special laboratories, and, worse still, the "crew" had to be reduced to a minimum, and thus a number of observations of various kinds had to be undertaken by each man.

Both the letterpress and plates of the volume are well printed, but we do not admire the character of the type used. Only the most trifling errors of spelling in technical terms mar the perfection of the English.

"THE FRAM." By Colin Archer. pp. 16, with 3 Plates. It is fitting in every way that the scientific results of the expedition should commence with a description of the wonderful ship which bore the expedition with such success. And what more fitting than that the designer and builder of the "Fram" should describe how she was built, how she was rigged and equipped, and, above all, how she was made capable of resisting what no ship had ever before successfully resisted, the overwhelming pressure of the polar ice.

The leading idea of the whole expedition was to get the "Fram" frozen fast in the ice, which, according to Nansen's famous theory, drifted across the North Pole. To do this a boat had to be built which would overcome that pressure which was generally believed to be irresistible. That such a boat could be built and has been built all the world now knows. Although it is probably less well known that notwithstanding the enormous ice pressure to which the "Fram" was subjected—so graphically described in "Farthest North"—on being carefully surveyed both outside and in the hold after her return, the only sign of straining which could be discovered in any part of the vessel was in one bolt which had started! No better testimony to the efficiency of Colin Archer's design and system of construction could be adduced. The most interesting and important points about the "Fram" are the strength of the structure which resisted the pressure and blows of the ice, and the design which enabled her to evade a pressure which might have proved fatal even to her. Wood from many trees and many countries go to make up the strength of the "Fram." Her keel is of American elm, her double frames are of well seasoned English oak, the main deck beams are of American or German oak, while the inner lining, the keelston, the lower deck and poop beams, and all the deck planking are of Norwegian pine. The outside planking is double and all oak, the inner layer being 3 inches and the outer 4 inches thick, while over this again is an ice sheathing of greenheart, 6 inches thick at and above the water-line, decreasing to 3 inches thick at the keel. The interstices between the frames are filled with a composition of coal-tar, pitch, and sawdust, the ship's side thus forming one compact mass varying in thickness from 28 to 32 inches. In his choice of model the builder was largely influenced by the idea that the "Fram" should be lifted by the ice, and that thus the force of the "nip" should be broken and deprived of half its terrors. "In order to utilise this principle," Mr. Archer writes, "it was decided to depart entirely from the usual deep-bilged form of section, and to adopt a shape which would afford the ice no point of attack normal to the ship's side, but would, as the horizontal pressure increased, force the attacking floes to dive under the ship's bottom, lifting her." How successfully this end was realised we know from Dr. Nansen's account in "Farthest North." Mr. Colin Archer's description of the "Fram" is excellent, and with the two plans accompanying it will form a very valuable aid to future Arctic work.—H. F. W.

"THE JURASSIC FAUNA OF CAPE FLORA, FRANZ JOSEF LAND." By J. F. Pompeckj. With a geological sketch of Cape Flora and its neighbourhood, by Fridtjof Nansen. pp. 147, with 3 Plates. This section forms a continuation of the work done by Dr. Kœttlitz, of the Jackson-Harmsworth Expedition. It is to some extent controversial, since Dr. Kœttlitz submitted his fossils to Mr. E. T. Newton, F.R.S., while Dr. Nansen's collection has been examined by Dr. Pompeckj, with results which differ in certain details. The fact that the fossils represent the most northern Jurassic fauna known to us adds greatly to their interest; and the publication of this work in English gives it a special claim on our gratitude and attention. The Jurassic clays of Cape Flora underlie a great capping of plateau-basalt, which has protected them in their adverse climatic position. Dr. Nansen remarks that the constantly frozen condition of the clays has probably prevented them from being pressed out and made to flow under the weight of igneous rock above them. Considerable interest was aroused when these strata were described before the Geological Society of London by Kœttlitz, Newton, and Teall, in 1897 and 1898, owing to the possibility that certain shales containing Jurassic plants were contemporaneous with the outpouring of the basalts. Dr. Nansen is now able to strengthen the view that "the greater part of the basalt is also of Upper Jurassic or Lower Cretaceous age" (p. 26)); Professor Nathorst has, moreover, come to the same conclusion respecting the basalts which he has investigated in Kong Karl's Land. The occurrence of terrestrial and estuarine strata of Jurassic age in these regions fits in with what we already know of the northern Jurassic province, from the Inner Hebrides to Brora, Andö, and onwards.

The result of Dr. Pompeckj's examination of the fossils, and of his comparison with the descriptions published by Mr. Newton, are clearly given on pages 108—133. Cadoceras is the prevalent ammonite, and the author concludes that no marine Jurassic strata newer than the Callovian are present. The Callovian is well represented. On the other hand (p. 127), Lower Bajocian marine beds are indicated in the strata N.W. of Elmwood. The differences between this correlation and that made by Mr. Newton are not of a very momentous character; but they affect to some extent our views as to the broad physiographic features of the Jurassic period (pp. 140—147). The alliance of the beds is shown to be with the Russian Jurassic, and even with the central European type (p. 137), rather than with the Jurassic of East Greenland.—G.A.J.C.

"FOSSIL PLANTS FROM FRANZ JOSEF LAND." By A. G. Nathorst. pp. 26, and 2 Plates. Cape Flora, the southern extremity of the group of islands known as Franz Josef Land is about 20 degrees from the Pole. How far northwards this Arctic archipelago extends is one of the many unsolved problems of the region of mysteries which lies within the Arctic circle. Franz Josef Land was accidentally discovered by Weyprecht and Payer during the search for the North-east passage in 1872-4. It was twice visited by Leigh Smith between 1880 and 1882, and at Cape Flora the Jackson-Harmsworth expedition was established in 1896, and was joined by Nansen and Johansen then on their sledge journey southwards. During his short sojourn with the English expedition Nansen studied the geology of the neighbouring country, and was frequently accompanied in his excursions by Dr. Kœtlitz, doctor and geologist to the expedition. Hearing of a "nunatak" (a spur of rock projecting through the sheet of ice), upon which plant-remains were to be found, Nansen's interest was aroused, and he and Dr. Kœtlitz visited it. "The spur of rock consisted entirely of basalt, at some points showing a marked columnar structure, and projected in the middle of the glacier at a height which I estimated at 600 or 700 feet above the sea. . . . At two points on the surface of the basalt there was a layer consisting of innumerable fragments of sandstone. In almost every one of these impressions were to be found, for the most part of the needles and leaves of pine-trees, but also of small fern-leaves. We picked up as many of these treasures as we could carry. . . . Some days later Johansen also chanced unwittingly upon the same place and gathered fossils which he brought to me."* Of these fossils Professor Nathorst gave a preliminary account in "Farthest North," and has now presented us with detailed descriptions and figures in the memoir before us.

The well-executed plates bear testimony to the exceedingly imperfect nature of the materials with which Professor Nathorst had to work. In his preface the author states that "most of the remains of the plants are very fragmentary, and as, moreover, the leaves in themselves are small, and are not by any difference of colour distinguishable from the rock, the examination of the material has been very arduous, having almost without exception

* Fridtjof Nansen. "Farthest North." Vol. II., pp. 483-4.

been made under the magnifying lens." This being so, it was above all essential that its examination should be conducted with that skill and caution which it is plain that Dr. Nathorst has brought to bear upon his task.

Considering the condition in which the fossils were found it is not surprising that their study has yielded no botanical or geological results of a startling nature. Their chief interest lies in the fact that "they give us our first insight into the plant world in the regions north of the eightieth degree of latitude during the latter part of the Jurassic period." The author concludes that these plant-beds most nearly resemble the "previously known Jurassic floras from Siberia and Spitzbergen," and either belong to the upper part of the Oxfordian group or represent even later deposits. Some doubt exists as to whether the plant-beds are in situ or have been intruded into the basalt, on account of which it is impossible to determine with certainty the geological position of the basalt. If Nansen is correct in supposing them to be in situ, i.e., interbedded between the basalts, we must assign the basaltic formation to the late Jurassic or early Cretaceous periods.

With regard to the plants themselves, Dr. Nathorst's work may be left to speak for itself. The shortcomings of this account of the fossil flora of the most northerly region of the globe which has been examined by the geologist and palæobotanist are confined, as far as we are able to see, to the unsatisfactory nature of the materials it treats of, and for this, neither author nor collector is responsible. We offer our congratulations to collector, editor, and author upon the production of a thoroughly efficient account of a collection representing a most interesting portion of the Jurassic flora.—H. H. W. P.

"AN ACCOUNT OF THE BIRDS." By Robert Collett and Fridtjof Nansen. pp. 54, with 2 Plates. The birds observed in the high latitudes traversed by the expedition were, as might be expected, few in number. Altogether 33 species are treated of in this account, which is divided into four sections, the first dealing with the Siberian Coast in the autumn of 1893, and the second treating of the first summer, being from Dr. Nansen's notes on board the "Fram"; the third section describes the birds observed during the famous sledge journey, while the fourth section gives the observations made on the "Fram" after Nansen and Johansen had left in March, 1895, until the return of the ship in August, 1896. Although the birds seen were comparatively few the observations are of much interest and value. The bird to which chief interest is attached is Rhodostethia rosea, Ross's wedge-tailed or roseate gull. This beautiful rose-breasted bird is a truly Arctic species, and was first discovered by Sir James C. Ross in 1823, on Melville Peninsula. Since then the bird has seldom been obtained while its eggs are quite unknown. The first Ross's gulls seen by the expedition were eight young birds in August, 1894, when the "Fram" was in about 81 degrees N. lat., and 127 E. long. These birds were all shot, and those preserved are the youngest birds of this species ever brought home. They were just able to fly, and are worthily represented in an excellent coloured plate and photographic reproduction appearing in the Memoir. The species was met with again and in considerable numbers by Nansen and Johansen in July and August, 1895, on the north-east side of Franz Josef Land, where it was obviously breeding — perhaps on Liv island — although the explorers were unable to discover the nesting place, indeed, as we know, they had not much time for bird's nesting. The bird record for farthest north is held by a Fulmar (Fulmarus glacialis), seen on September 14th, 1895, when the "Fram" was in 85 degrees 5 min. N. lat., but had it not been for the fact that Nansen and Johansen made their "rush" for the north too early in the spring for birds to have appeared it is probable that even this record would have been beaten. No less than ten species were observed in the autumn of 1895, while the ship was north of 84 degrees, one of these being a little land bird—the snow bunting. The exact details given in each section regarding dates, localities, and habits of the birds observed make the account doubly interesting and valuable.—H. F. W.

"CRUSTACEA." By Professor G. O. Sars. pp. 137, with 36 Plates. For the last forty years Professor Sars has been publishing, almost annually, some important contribution to our knowledge of crustacea, and has often issued several such works in a single year. Whether his capacity was inherited from his eminent father, Michael Sars, or was the result of early environment, others may decide, but the indisputable fact is that in carcinological literature he became a classic at the outset of his career. To the accuracy of observation and ardour of pursuit with which he began, and which have never fallen off or flagged, he has since added two qualifications, one of which is fitted to endear him to naturalists of our land and the other to naturalists all the world over. After experimenting with Norwegian, Latin, and French, for vehicles of scientific exposition, he has finally made himself an accomplished writer of English, as his present and all his recent works bear witness. Furthermore, he has mastered a still more cosmopolitan language, by becoming an artist so facile and so faithful, that, even if he described his species in an unknown tongue, their structure would be adequately understood from his skilful and copious drawings. The work before us contains no less than thirty-six plates, full of instructive details in regard to Amphipoda, Copepoda, and Ostracoda.

The pelagic Copepoda obtained greatly preponderate in numbers over the other groups, and for this an explanation is given in the introduction. In preparing the "Fram" for its projected expedition, the assumption of geographers had been accepted "that the Polar basin, north of Siberia and Franz Josef Land, could only be quite a shallow sea, with depths scarcely exceeding some hundred fathoms," and the zoological equipment was arranged accordingly. But then a wonder came to light. Enormous depths were met with. No rope has been provided for dredging or trawling in such abysses. Even for sounding a makeshift line had to be constructed out of the wire ropes of the vessel. For a water bottle or an ordinary lead this long drawn thread of steel sufficed, but not for hauling a dredge. This was disappointing, because, not only were the superficial strata of the almost ice-covered sea abounding in life at all times of the year, and to the highest latitudes reached, but the greater depths excited tantalizing expectations, for "in many cases the tow-net was lowered to depths exceeding 200 or 300 metres, and, as a rule, the draught was considerably richer in such instances than when it was working in smaller depths."

The sounding-line, however, produced at least one interesting faunistic result, in which we find aristocratic names mixed up with singular coincidences and remarkable facts of distribution. First it should be mentioned that the "Challenger" brought home a single specimen of a new amphipod, about half-an-inch long, from a depth of 420 fathoms, in the Pacific, off Tahiti. This was described under the name of Cyclocaris tahitensis, and it is a rather peculiar member of the family Lysianassidæ. To obtain a second specimen of this unique rarity one can imagine a rich enthusiast giving instructions for a search in the southern ocean. That has not yet occurred, but something less to be expected has come to pass. Dredging off the Lofoten Islands in 1898, at a depth of 1095 metres, the Prince of Monaco obtained among other valuable captures six specimens of a Lysianassid which M. Chevreux has named Cyclocaris Guilelmi. The generic name was necessary from the fact that the species stood in the closest possible relationship to the type from Tahiti. The specific name was given by special request of the Prince in compliment to the Emperor of Germany, who was on board the "Princesse Alice" when the dredge containing the new species was hauled in. But Prince and Emperor were not the first to obtain this bright red polar form. Already in 1894, at about the 80th degree of north latitude, it had been taken by the Norwegian Expedition, and Sars in discussing it says, "I had intended to dedicate it to our celebrated explorer, Professor Nansen." But neither was Nansen the first to secure it, for Canon Norman has just published, under the name Cyclocaris faroensis, a species which cannot, I think, be distinguished from that which has an Imperial namesake, and Norman's description and figures are based on "two specimens taken by Sir John Murray in the 'Triton' expedition of 1882, Stat. 8, Faroe Channel, lat. 60 degrees 18' N., long. 60 degrees 15' W., in 640 fathoms, temperature 30 degrees Fahr." The name given by Chevreux has priority, since his specimens, though the latest found, were the earliest described. Of those taken by the "Fram," the first were found clinging to the sounding line, but others were subsequently taken in the tow-net, and one at least was so obtained at a station "north of the 85th degree of latitude," therefore more than a hundred degrees of latitude distant from its twin species off Tahiti, to which all three authors notice its resemblance.

Apparently for Amphipoda the record of "farthest north" is at present held by Amphithopsis glacialis, Hansen, which, along with half a score of species of Copepoda, is reported as having been taken at "85 degrees 13' N. lat., 79 degrees E. long."

Among the interesting new Copepoda which Sars here describes there is one which he names Hemicalanus spinifrons, giving a cogent reason for cancelling the generic name but leaving it uncancelled. He is more concerned with a point of more importance. No one of the eleven species hitherto included in the genus has ever been found north of the Mediterranean, so that it seemed to be quite southern in distribution. "It was therefore," Sars observes, "not a little surprising to find a specimen undoubtedly belonging to this genus in a sample taken from about the centre of the Polar basin traversed by the 'Fram.'" This and various other facts relating to the range of species and genera will no doubt attract the keen attention of naturalists, and these fruits of Arctic research will greatly strengthen their hopes of a rich harvest from Antarctic exploration.

XUM

Among the honours which may in some degree have compensated Nansen for the hardships of his Polar experiences, this fine contribution to the scientific results by his distinguished brother-in-law is entitled to stand in the front rank.—T. R. R. S.

"WIRELESS TELEGRAPHY AND HERTZIAN WAVES." By S. R. Bottone. (Whittaker.) 3s. The fourth and last chapter of this volume occupies nearly half the book, of which it forms by far the most useful and interesting portion. The author is evidently well versed in the requirements of the numerous amateur electricians who have much enthusiasm but few tools and little knowledge of their use. To amateurs of this class we can recommend the volume for the sake of this chapter. The instructions both for making and using the apparatus are given with such minute attention to practical and essential details that it is evident that the author has himself experimented with apparatus constructed by him in the manner which he describes. The introductory chapter is the least satisfactory part of the book. The very brief statement of certain elementary electrical facts would be of very little if any assistance to a reader having no knowledge of the subject and superfluous for others. Parts of it, moreover, are misleading. Both on pages 1 and 12 it is stated that an electrically charged body consists in rapid molecular vibration, and on page 3 it is suggested that conductors are bodies which freely transmit electrical vibrations while insulators do not. Now one of the things we do know about electricity is that insulators are the best transmitters of electric waves, and that the better conductor a body is, the more imperfectly does it transmit these waves, indeed a theoretically perfect conductor would act as an absolute screen to the transmission of electric action, being impenetrable to electric vibrations. On page 10, again, the author, referring to the strained condition of the insulating medium near electrically charged bodies, treats the air as a rigid substance, and does not seem to be aware of the physical properties of gases.

We should advise the author in his next edition to suppress this chapter entirely, and devote the space to enlarging chapter II., which might be done with advantage. It would also be advisable in a new edition to draw a clearer distinction between Mr. Preece's system of wireless telegraphy by means of electro-magnetic induction, and the utilization of the Hertzian waves which forms the basis of the system which has been brought into practical shape mainly by the indefatigable industry and skill of Mr. Marconi, aided as he has been by Mr. Preece and the resources of the British Postal Telegraph Department.

"OBJECT LESSONS IN BOTANY." Book II. By E. Snelgrove, B.A. (Jarrold.) Illustrated. 3s. 6d. One hundred lessons from forest, field, wayside, and garden, are herein embodied and neatly illustrated with simple woodcuts. The author's ideal in planning his work is thus expressed—"Whether education or mere instruction be its aim, that book is most likely to succeed that leads its readers along the same paths as the discoverers of the science must themselves have followed. Students should not have facts thrust at them, but should be shown how to find them out; steps should be made, not simply taken; conclusions should be drawn, not merely stated; definitions should be led up to and not started from." The lessons are designed to suit the capacities of children from nine to eleven years of age, and we think Mr. Snelgrove has very closely approximated to the laudable standard he set out to attain.

"CHATTY OBJECT LESSONS IN NATURE KNOWLEDGE." By F. W. Hackwood. (Longmans.) Illustrated. 3s. 6d. Here are brought together, in convenient form, a good selection of outline lessons on the common objects of nature. Teachers who experience difficulty in preparing object-lessons of this kind will find Mr. Hackwood very helpful in the way of suggestion. A number of drawings, white on black, are scattered throughout the volume to serve as auxiliaries to the teacher in sketching on the blackboard

"THE STRUGGLE FOR EMPIRE." By Robt. W. Cole. (Elliot Stock.) Mr. Cole in these pages makes an ingenious attempt to describe a great war between England and the inhabitants of the star Sirius in the year 2236 A.D. Those who enjoy following in the wake of the visionary may here find pleasant reading for an hour or two. War ships of the future according to the author's notion will be closely allied to Jules Verne's "Clipper of the Clouds." Of course, in the war with Sirius England wins, but only after a great sacrifice of life and ships. It is interesting to observe that the war office of this future period is credited with the fault ascribed to that of the present day, namely, unpreparedness.

"AN ESSAY ON MENTAL CULTURE." By G. A. Hight. (Dent.) 3s. 6d. net. Our author seeks to impress on the mind the supreme importance of intellectual culture in these latter days, and the necessity for self-reliance in the solution of the many perplexing questions evolved by advanced thinkers. The book is an essay—nothing more: it contains much sound matter with which all thoughtful readers will agree, but a considerable portion is distorted by a strong personality. Plain speaking, indeed, is the most characteristic feature of the essay; right or wrong the author may be, yet truth and error are delivered with the same unreserve.

"SIGNALLING THROUGH SPACE WITHOUT WIRES." (The work of Hertz and his successors.) ("Electrician" Publishing Co.) ii. and 133 pages. This is the third edition of Professor Lodge's well-known little volume, generally known by the second title quoted above, which formed the first title in the first two editions. This third edition contains some 27 pages of interesting additional matter, including notes on his own recent researches in syntonic telegraphy. In referring to Professor Slaby's work on Spark Telegraphy, and to his having succeeded in signalling from 3 to 13 miles across land, Dr. Lodge inadvertently does an injustice to Marconi in not pointing out that, according to Professor Slaby himself, he had not got beyond 50 metres until after he had witnessed Marconi's earlier demonstrations.

"THE FLOWERING PLANT." 3rd Edition. By J. R. Ainsworth Davis, M.A. (Griffin.) Illustrated. 3s. 6d. Actual dissection of the plants studied is insisted on by the author of the book under notice, to facilitate which easily obtained objects are figured and described instead of rare and often inaccessible ones. A special chapter on ferns and mosses forms the chief feature in this edition, an innovation which will be appreciated by most teachers, seeing that these plants are abundant everywhere and so imperfectly understood outside the ranks of the specialists.

"THE THEORY AND PRACTICE OF INTERPOLATION." By Herbert L. Rice. (Nichols Press: Lynn, Mass.) Professor Rice endeavours to give a simple, practical, yet comprehensive discussion of all that is useful concerning differences, interpolation, tabular differentiation, and mechanical quadrature—a complete exposition of all the tables required by a practical computer. Many of the tables are here printed for the first time, and are true to the nearest unit of the last figure. We note with regret that references to the writings of Walmesley, Mouton, and Lalande have been purposely omitted "because of the general inaccessibility of their works." Although the author has used with discretion the works of such writers as Encke, Loomis, and Newcomb, he has drawn very largely on his own resources in preference to the usual forms of analysis, but the subordination of facts and figures has been so thorough and masterly in the Professor's hands that we feel convinced the fundamental principles involved stand out the clearer as a result. The computations were all made in duplicate by independent methods, so that the absolute of accuracy is thus as near as may be attained.

"FERRIC AND HELIOGRAPHIC PROCESSES." By George E. Brown, F.I.C. (Dawbarn & Ward.) Illustrated. 2s. net. Practical in character and limited in scope, this book is intended to supply amateur photographers, draughtsmen, engineers, architects, surveyors, and others, who find the reproduction of tracings and drawings a matter of every-day necessity, with just enough exact knowledge to duplicate pictures and drawings by the so-called "blue process." Many devices are employed for varying the background so as, for example, to get a brown or other colour in place of the Turnbull's blue—effects produced by the employment of tinted paper or other means. Thorough working details are presented so that anyone with the aid of this book may readily master all the phases of the art.

"LIFE AND CORRESPONDENCE OF DR. ARNOLD." By Dean Stanley. (Ward, Lock.) Illustrated. 2s. "Arnold of Rugby" is a name more or less familiar to all. When we mention the fact that this work went through twelve editions during the late Dean's lifetime, its merits will be sufficiently apparent. The chief point about the present edition is that the book is presented in a most attractive form at a price within the means of the largest number. By far the greater portion of the volume is occupied with the great teacher's correspondence suitably interspersed with biographical details by his devoted pupil. Two good portraits of the master are given, together with views of the places Dr. Arnold was associated with during his lifetime.

We have received the August issue of the "Theosophical Review" (1s.), the organ of the Theosophical Society, containing contributions from Dr. A. A. Wells, Mr. A. H. Ward, and other writers. Persons interested in the subjects treated of in the Review should communicate with the Hon. Otway Cuffe, at 28, Albemarle Street, London. The publications of the Theosophical Publishing Society may be obtained at 3, Langham Place, London.

We have received two catalogues of physical apparatus from Messrs. Griffin, which will recommend themselves to those science teachers who are engaged in organised courses, and also to students working up for the London University practical examinations. This firm has adopted the excellent idea of making up complete sets of apparatus to suit the experimental portions of most of the well known text-books, and thus a great deal of time may be saved

by teachers and others desirous of following any special course of instruction. We note also that Messrs. Griffin have issued some special X-ray regenerative tubes for use with Wehnelt's electrolytic break.

BOOKS RECEIVED.

Principles of Chess. 3rd Edition. By James Mason. (Horace Cox.) 2s. 6d.

A Romancer's Local Colour. (Pamphlet.) By S. R. Crockett. (Newman & Guardia.)

White Cattle: an Inquiry into their Origin and History. By R Hedger Wallace. (Reprinted from the *Trans. of the N. H. Society of Glasgow.*)

Variable Star Notes. No. 6. (Rousdon Observatory.)

Instructions for the Use of the Calculus. By W. Gorn-Old. (Dollond: London.)

Subject List of Works on Photography. (Patent Office Library Series: No. 2.) 6d.

Feilden's Magazine, August, 1900. 1s. net.

Flora of Bournemouth. By Edward F. Linton, M.A. (Mate and Sons: Bournemouth.) 8s. 6d. net.

The Application of Electric-Motors to Machine-Driving. By Andrew Stewart, A.I.E.E. (Rentell: London.) 1s.

West Ham Public Libraries: Annual Report, 1899-1900.

Miniature Chessboard and Chessmen. (British Chess Co.) 2s. 6d.

Over the Alps on a Bicycle. By Mrs. Pennell. (Unwin.) 1s.

Bulletins de la Société D'Anthropologie de Paris.

A Handbook of Photography in Colours. By T. Bolas, Alexander A. K. Tallent, and Edgar Senior. (Marion.) 5s.

An Account of the Oldest Books in the World. By Isaac Meyer, LL.B. (Kegan Paul.) Illustrated. 30s. net.

Nuove Osservazioni di Marte. V. Cerulli. 1898-99.

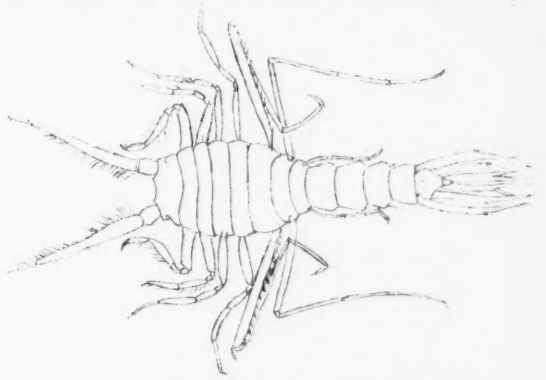
THE KARKINOKOSM, OR WORLD OF CRUSTACEA.

By the Rev. THOMAS R. R. STEBBING, M.A., F.R.S., F.L.S., F.Z.S., *Author of "A History of Crustacea," "The Naturalist of Cumbrae," "Report on the Amphipoda collected by H.M.S. 'Challenger,'" etc.*

THE MANY-TWINKLING FEET.

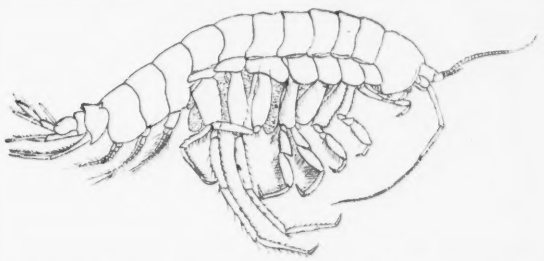
AMPHIPODA are much more abundant and useful than amphitheatres, though their name is less familiar. An amphitheatre is well conceived for convergent eyes, and an amphipod for divergent legs. Imagine the central space of an amphitheatre to be the body of an animal and its radiating gangways the legs, and you may then understand something of Latreille's intention in coining the word Amphipoda, which signifies, as he explains it, feet extended in every direction. These feet are not stiff and stony and uniform in pattern like the gangways to which I have compared them, but mobile, many-jointed, endlessly diversified, and, moreover, capable of being uplifted or downward bent at all sorts of varying angles. Like the Isopoda of the last chapter, the Amphipoda are fourteen-footed. That is to say, besides several other more or less leg-like appendages, they have seven pairs of legs attached to the central trunk. Just think what nature can do in the way of variety with us poor quadrupedal or quadrumanous creatures, making the front legs so long in the giraffe, so short in the kangaroo, so solid in the elephant, so slender in the gazelle, so handy in ourselves, so invisible in the bashful snake, and then fancy, if you can, how the same nature may run riot when there are seven pairs of limbs to play with instead of only two. The opportunity is not neglected.

Seeing that the majority of the Amphipoda take their pastime or at any rate pass their time in the ocean, a common environment might seem unfavourable to variability. But the environment, though continuous, is multiform, from surface to abyss, from tropical heat to glacial temperature, from strong salinity to a slight brackishness, from semi-stagnation to wild waves and racing currents, from pelagic expanse to the space between tidemarks, from tracts of mud and smooth fine



Scina rattrayi, Stebbing. Hyperid from Atlantic.

sand to coral reefs and ragged rocks, where the lost mermaiden dwelt of yore among the still-surviving tangle of many-coloured algæ and zoophytes. Into all these situations, romantic or prosaic, and into some others, Amphipoda have found their way. Not so easy a thing is it to bury yourself in sand or sticky mud, and then to unbury yourself as if nothing had happened, with your coat as shining as before and every delicate hair uninjured. But many species of amphipods can accomplish this. To walk, to run, to climb, to delve, to build, to grasp the prey, to clasp the beloved one, to shelter the brood—these are obvious among the functions of the fourteen feet, as illustrated in the life-history of various species. How easily it all appears to come about, by shortening one joint, and lengthening another, widening this and narrowing that, with a little notching and sculpturing of margins, inflating or flattening of surfaces, curving the straight, straightening the crooked, feathering a hair, fortifying a setule into a spine, and behold for every function there arises its adapted form in permutations and combinations which arithmetic proclaims to be inexhaustible.



Pardalisca abyssi, Boeck. Gammarid, with eyes imperfectly developed.

This is a happy moment for beginning the study of the Amphipoda, because at present the order has definite and undisputed boundaries. Nothing that is not an amphipod wants to be one, nothing that is an amphipod wants to trek. First, there are the branchial sacs, simple or almost simple, not enclosed in a branchial chamber, and belonging to some of the trunk-limbs. Secondly, there is the pleon, which never has more than three pairs of swimming feet with lash-like branches. This combination of characters protects the Amphipoda from being confused with any other known crustaceans.

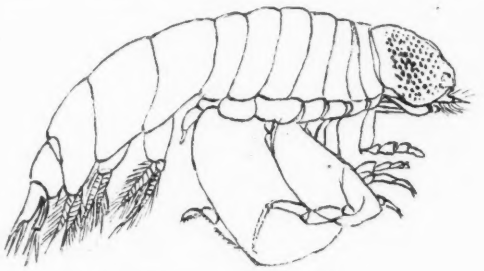
XUM

Also among themselves they form three groups to which nature has been pleased to give a rare distinctness. These are known as the Gammaridea, Caprellidea, and Hyperiidea, names derived from an early defined genus in each, to wit, *Gammarus* for the first, *Caprella* for the second, *Hyperia* for the third. The middle set resemble Manx cats and mankind and some other more or less interesting creatures in the circumstance that they have lost or nearly lost their tails, that part of the body which in the higher crustaceans is decorously designated the pleon. In the other two sets this part is rather powerfully developed, almost always carrying its proper complement of appendages, namely, three pairs of pleopods for swimming and three of uropods for jumping or some equivalent mode of progression. The pleopods show comparatively little variation, each usually consisting of a stout stem to which are attached two branches, many-jointed, and feathered with long setæ which are themselves feathered. The Gammarids and Hyperids are distinguished one from the other by a character in which the Gammarids agree with the Caprellids, a character not of the tail but of the head. The maxillipeds in the Hyperiidea have only three joints, the remaining four having for some mysterious reason vanished, whereas in the other Amphipoda some and usually all of these joints are present. Whether, therefore, by the head or the tail the three divisions of the order are clearly distinguished and at the same time closely linked together.

Parvipalpus linea, Mayer. From Mayer.

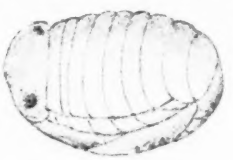
The Caprellidea embrace two families, the Caprellidæ and Cyamidæ. The former of these are familiarly spoken of as spectre-shrimps and skeleton-shrimps, and in one of these species, the *Parvipalpus linea*, Mayer, here figured, tenuity reaches perhaps its furthest amphipodan limit; nor does this precious specimen make up for want of breadth by any unnecessary length, since it is only two-fifths of an inch long. It may be proper to mention that in the lateral view, according to carcinological custom, the antennæ and legs of one side only are portrayed. The third and fourth peræopods are missing by accident. The first and second are missing in nature, nothing of them remaining but the little branchial sacs. Thus artistic convention, the frailty of the specimen, and nature's thrift, have combined to present the picture of a three-footed animal, which nevertheless has ten feet by rights, and by classification belongs to a fourteen-footed order. Cousins to the skinny clambering Caprellidæ, and closely resembling them in structure, are the more sedentary Cyamidæ, commonly known as whale-lice. In appearance these greatly differ from their near relations, because, instead of being cylindrical and thread-like with geniculating bodies, they are comparatively broad and flat, adapted for close adhesion to the skin of their gigantic hosts. The Caprellidæ are ascetics, subduing the flesh to such an extent that substance runs a risk of passing into shadow. The Cyamidæ, having adopted a lethargic life in oleaginous luxury, seem to be gradually recovering some of that corporeal amplitude which is appropriate to the epicurean.

The Hyperids are not quite so accessible as the other two groups, being rarely found in England between tide-marks, except when thrown up by storms, either independently or on the jelly-fishes, which some of them frequent. Many of them are distinguished by the



Tetrathyrus moncœuri, Stebbing.

extreme development of the eyes and by the glassy transparence of the body. Often in the female the second pair of the antennæ are obsolete. In the male the same pair frequently show a curious arrangement. They have delicately slender joints of great length, which, when not in use, can be folded together like a carpenter's rule and tucked away securely at the sides of the animal. In some genera the folding plan is carried further, being applied to the whole body, as in the *Tetrathyrus moncœuri* and *Dithyrus faba* here figured. In *Tetrathyrus*, "four doors," and *Dithyrus*,



Dithyrus faba, Dana. From Dana.

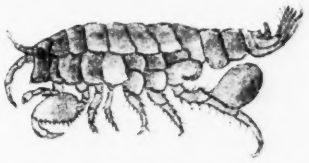
"two doors," allusion is made to the greatly expanded joints of the two pairs of legs which precede the tiny last pair. It is a peculiar function for leg-joints to have to assist in armour-plating the owner's body. A comparison of the two figures will show how the animal by the infraventral folding of the broad joints in question, and the approximation of its head and tail, becomes a smooth little egg-like box, as compact a fortress of its kind as could well be devised. Very different in appearance but not so very different in structure is the *Calamorhynchus rigidus*, of which a dorsal view is given,

Calamorhynchus rigidus, Stebbing.

that does not show the rather insignificant legs. Its generic name, meaning "pen-beak," is appropriate to the form of the head in mature life, but it is born blunt-headed.

Of the three groups, the largest publicity and prominence has been obtained by the Gammaridea, and one can easily believe that from this type the other two are derived, because in each of those other two a feature has become degraded or lost which the Gammaridea still retain. The Gammaridea alone of the three have made their way into fresh water and on to dry land. It is, indeed, a fresh water species, *Gammarus pulex*, which the student has always at hand as a simple

pattern with which to compare the innumerable modifications presented by the order at large. But *Gammarus marinus* on the shore and *Gammarus locusta* from the shore into tolerably deep water will provide him with equally suitable standards of comparison. To the eye of the beginner these three species will probably look as like as three peas, and will therefore serve him as a useful exercise in discrimination. The amphipods that have taken to life on land are not as yet very numerous. They all belong to the Talitridæ, a family better known as sandhoppers and beach-fleas. These show a great and good ambition to walk uprightly, but their education in the ways of sub-aerial life is evidently still in progress. Many are as yet in the stage of making experiments that are not always successful. Some, like the *Talorchestia* here depicted, steady



Talorchestia telluris, Bate. From Bate.

themselves by remarkable expansions of certain joints in the hinder limbs. Other devices are found in other families for species that whether in or out of water favour an ambulatory gait. In the open air an animal that falls over on its side and can then only move on by jerks and wriggles must painfully feel that, the more legs it has, the more ridiculous it looks.

Though species of amphipods swarm in all seas, they make themselves more than usually conspicuous in Arctic waters. Fittingly, therefore, the earliest intelligible description of any amphipod resulted from a voyage to Spitzbergen and Greenland. Friderich Martens, a barber-surgeon on board a whale-ship, toward the close of the seventeenth century, may be said to have discovered them. Some of the largest and most abundant of the smooth Arctic forms were described in 1774 by Captain Phipps, afterwards Lord Mulgrave, and some of the thorniest forms a little later by the Russian writer Lepekhin. *Eurythenes gryllus*, long the champion gammarid, was not made known till 1822. It has been found exceeding four and a half inches in length, with girth in proportion. It is in colour rosy with a tinge of yellow, and has its limbs æsthetically picked out with vermilion. Regardless of its array, petrels and sharks and other pirates swallow it without remorse. Their greediness first gave it to science, for Mandt, its discoverer, says, "the only specimen I brought back from my journey was vomited by an Arctic petrel." Sailors, after their wont, angling in the air for sea-birds, caught the petrel and gave it a mortal crack on its skull, whereupon it disgorged the crustacean, well digested, yet with the chitinous framework scarcely injured. This amphipod has a vast range from north to south. Also it descends through various depths to the greatest reached by any species of its order. Sea-birds must capture it near the surface, but whether they find it there alive or dead is uncertain. In any case one may still admire its powers of navigation, though it no longer holds the record for size. *Alicella gigantea*. Chevreux, dredged by the Prince of Monaco in 1897 from a depth of 2890 fathoms, is five and a half inches long, thus beating the longitude of *Eurythenes gryllus* by an inch.

At the beginning of this chapter stress was laid on the variability of the seven pairs of trunk-limbs. There are twelve other pairs of appendages also more or less variable, but here at the end of the chapter it is impossible to expatiate on the changes they exhibit with their branches double or single, their joints many or few, their teeth and lobes, their hooks and spines, their feathers and functions. Even the eyes, which have no joints at all, and which are normally two, seated laterally on the head, are far from displaying monotonous similarity. For, instead of two, there may be four or three or one or none. They or it may be on the top of the head instead of at the sides, and on the projecting tip or further back. They may be compound or simple. The outline may be circular, oval, or collar-like, it may be reniform, lageniform, fusiform, that is, like a kidney, a flask, or a spindle, or it may be in divers ways irregular. The elements may be few or so numerous as to cover almost the whole cephalic surface. The colour may be bright red or brown or green or ferociously black, or again it may be white or grey or variously pallid to evanescence. There is just that one point of consistency about the eyes, that they are never stalked, never articulated. By a hemispherical bulging they may occasionally try to intimate that they could grow a stalk if they choose, but they never do choose.

In conclusion it may be said that persons of a fine sporting instinct, who desire to be exhilarated by the chance of experiencing savage nips and pinches, lacerations, stabs and bites, will find the Amphipoda of no use. Such persons must pursue the crab, the lobster, the prawn, the squilla, and the isopod. Among the Amphipoda there are a few species armed with strictly defensive spines, but otherwise they are of all the Malacostraca the most absolutely and universally peaceable towards mankind, never intentionally inflicting upon him any personal injury whatever.

Sir John Murray and the Black Sea.

Sir John Murray recently delivered a lecture on the Physical, Chemical, and Biological Conditions of the Black Sea, to the Fellows of the Royal Society of Edinburgh. The Black Sea has peculiarities which distinguish it from the Mediterranean, Atlantic or Pacific. The greatest ascertained depth is 1200 fathoms. A surface current flows continually from the Black Sea into the Mediterranean through the Bosphorous and Dardanelles, and an undercurrent of salt water from the Mediterranean into the Black Sea. This undercurrent of water was found to be warm and to sink to the bottom, and in consequence of its great density prevented vertical circulation. The result was that these deeper waters were rendered quite stagnant. They were saturated with sulphuretted hydrogen and consequently life was impossible. In an expedition in which the lecturer took part, the water brought up by means of a water bottle from a depth of 300 fathoms smelt exactly like rotten eggs. No life therefore is possible in the Black Sea beyond a depth of 100 fathoms, which was a striking contrast to what happened in the open ocean, where there was an abundance of animal life at that depth. This brought about another extraordinary condition with reference to the deposits, viz., that in all the deeper deposits there is an abundant chemical precipitate of carbonate of lime, a condition of matters that obtains as far as is known in no other ocean.

XUM

Microscopy.

By JOHN H. COOKE, F.L.S., F.G.S.

The following simple method for examining the gonococci of purulent ophthalmia is suggested by Dr. W. B. Canfield. A little of the pus is pressed between two cover glasses, which are then drawn apart. The glasses are allowed to dry, and are quickly passed through a Bunsen flame to coagulate the albumen and to fix the pus. A few drops of the ordinary methylene blue or violet are allowed to cover the specimen for a few minutes and washed off, after which the specimen may be examined in water or glycerine, or it may be dried and mounted in balsam, which makes it more distinct.

Permanent preparations of blood—amphibian for preference as the red cells are so large and contain such prominent nuclei—may be prepared by allowing fresh blood to fall drop by drop into a solution of osmic acid (two per cent. acid solution, one part; one per cent. solution of sodium chloride, two parts; distilled water, one part). The solution should be constantly stirred while the blood is dropping. Allow the blood and acid to stand one night, and then wash the acid away with distilled water. Add alcohol, then clove oil, in which the blood may be kept indefinitely. Before the alcohol is added, the nucleus of the corpuscle may be stained in alum-carmine; or the whole corpuscle may be stained in aniline blue. Mount in balsam.

A warm slide is an indispensable piece of apparatus to the student of histology. In the study of amæboid movements it is essential unless a suitable spot in the frog's web can be found. To make a warm stage, take a strip of copper the size of a glass slide, and make a diaphragm opening in the centre. Attach a long strip of copper to this—or the whole can be of one piece—sufficient to project about four inches over the edge of the stage of the microscope. The flame of an alcohol lamp heating the end of this strip will, by conduction, heat the whole piece together with the slide placed on it. A drop of blood being prepared for examination in the usual way, make a ring round the cover glass with oil to prevent evaporation, place on the warm stage, apply the heat, and the leucocytes can be studied in their movements with higher powers and with greater ease than in the frog's web.

A water bath is another very necessary adjunct where a certain very moderate degree of heat is not to be exceeded. Few persons fully appreciate the difficulty of regulating or even estimating the temperature of an object held over a naked flame, and mischief is often done before the operator is aware of it. A serviceable water bath is easily extemporized out of an old fruit can and a small beaker glass. This serves for exposing material and preparations to a temperature lower than that of boiling water. Where slides are to be so heated, the simplest contrivance is a flat tin box, with all the joints (cover and all) tightly soldered. A small tube closed with a cork serves to admit the water.

Sections of buds may be quickly prepared for class demonstration by the following method. Fix the specimen in the section cutter, wet it with alcohol, and slice off the sections, meanwhile keeping the knife flooded with alcohol. Place the specimens in alcohol tinged with iodine green, and leave them there for several hours until the solution becomes colourless. Next place them in a solution of alcohol and eosin, and leave them till they assume a pink colour. Pass them through an alcohol bath, immerse in clove oil for a few minutes, and mount in Canada balsam.

The curriculum of the elementary school has recently undergone a much needed and welcome reform. The new code contains, inter alia, the official sanction of the Board of Education for the recognition of nature study as a means of educating the children of the people. This is a step in the right direction, for when children are early taught the nature study of every-day life, and become familiar with the common things in nature around them, their ideas as to cause and effect in natural phenomena will cease to be associated with superstition and mystery, and the range of available information open to them will be indefinitely extended. No education that does not include a knowledge of the every-day phenomena of nature can be regarded as complete; and as there is a very wide range of the most essential and practical knowledge that can be reached only through the microscope, the day may perhaps be not so far distant when the microscope, as an aid to nature study, will be used more extensively and more seriously in our public schools than it is at present. There is no reason whatever why a compound microscope of low magnifying power should not be just as much a common appurtenance of a well-regulated elementary school as a blackboard or a piano.

All who are interested in microscopy and photo-micrography should obtain a copy of an interesting little brochure entitled "Orthochromatic Photography," which is being distributed gratis by Messrs. Cadett and Neall, Ashstead, Surrey.

We have recently had an opportunity of experimenting with the "Absolutus" light filter used in conjunction with the Cadett Lightning Spectrum plates. The great rapidity of these plates, the sensitometer number of which was 360, renders them specially suitable for photographing the movements of microscopic plants and animals, while their extreme sensitiveness to all colour luminosities of the spectrum, excepting a very small margin at the extreme red end of the spectrum, enable them to represent with great delicacy the gradations in the coloured luminosities of stained preparations. The "Absolutus" light filter, which is specially adjusted for the spectrum plate, renders all gradations correctly with but a very small margin of error. It may be used either before or behind the objective. Its use increases the exposure at a window with a northern outlook about twenty times, but this is really no drawback with the Lightning plate, as, owing to its great rapidity, the exposure necessary is invariably shorter than it would be when using an ordinary plate without a filter. The surfaces of the "Absolutus" are optically worked, and the colouring accurately adjusted by the help of Abney's colour sensitometer to suit the spectrum plate. Workers with light filters know the unsatisfactory nature of ordinary coloured glasses and fluid cells. The care bestowed on the manufacture of the "Absolutus" eliminates most of the objections, and, in addition, the colouring of the screen is pleasant to the eye, and it does not interfere with the definition of the image.

[*All communications in reference to this Column should be addressed to Mr. J. H. Cooke at the Office of* KNOWLEDGE.]

NOTES ON COMETS AND METEORS.

By W. F. DENNING, F.R.A.S.

NEW COMET.—In justification of our statement in last month's notes that it was highly probable we should shortly hear of a discovery in this field, a bright comet with a tail was discovered by Borelly at Marseilles, and by Brooks at Geneva, U.S.A., on the night of July 23. The comet was moving rapidly northwards. The position at discovery was given by Borelly as 2h. 43m. 40s., Dec. + 12° 30′ in the extreme S.E. region of Aries. On the following night the comet was observed by Bigourdan at Paris, and the daily motion was found + 16′ in R.A. and + 2° 48′ in Dec. On July 30 it was seen at Bristol in a 6¼ inch refractor; it was a conspicuous object with a bright tail, and in the beautifully clear sky which prevailed soon after midnight the comet was just perceptible to the naked eye.

GIACOBINI'S COMET.—This object has now become exceedingly faint and is rapidly passing beyond the sphere of our observation. Its place on September 2 will be R.A. 17h. 39m. 7s., Dec. + 17° 58′·3, and its distance from the earth will be 169 millions of miles. The aspect of the comet will be such that only the largest telescopes will be able to deal effectively with it.

DE VICO'S COMET (1844 I.).—This object, which was computed to revolve in a period of about 5½ years, was not redetected during the half century which followed its discovery, but in August, 1894, Mr. E. Swift, son of the famous and veteran comet finder Lewis Swift, found a small periodical comet, the elements showing a striking resemblance of orbit to that of De Vico's comet, and it seemed probable that the two bodies were identical, allowing for some slight differences of orbit introduced by planetary perturbation. The return of the comet is now due, but the circumstances are not very favourable. In Ast. Nach. 3653 Seares gives a sweeping ephemeris, from which it appears that the object on September 2 will be in R.A. 16h. 17m. 19s, Dec. S. 25° 5′. This position is less than 1° N.E. of the star σ Scorpii, the place of which on January 1, 1901, is R.A. 16h. 15m. 10s., Dec. S. 25° 21′. The bright star Antares will be only 2 degrees E.S.E. of the comet at the same time. The latter will be about 190 millions of miles distant from the earth early in September, and far beyond the reach of ordinary telescopes.

FIREBALLS.—In the strong twilight at 8h. 47s. on July 17 a splendid fireball appeared over the north of England, and left a streak visible for more than three quarters of an hour. It moved somewhat slowly from south to north, and the nucleus burst out with great brilliancy several times, finally dividing into two fragments. Dr. C. O'Hara, of Burnley, describes the meteor as falling at an angle of about 45 degrees, and in a low altitude a little east of north. At Spennymoor, Durham, its direction of flight was noted from 50° over the S.E. horizon to 15° above N.N.E., and duration 2½ or 3 sec. The same observer says the fireball consisted of two pear shaped masses, tailing off behind into two parallel streaks of vivid white brilliancy accompanied by blue and crimson coruscations. The writer has received about 15 accounts of the meteor from various observers in the N. of England and Scotland. The real path of the object appears to have been from a height of 58 miles over Pickering, Yorks, to 15 miles over the North Sea. Its length of observed path was 175 miles, and its astronomical radiant point was at 249°—20° a few degrees N.E. of Antares in

Scorpio. The meteoric system to which this brilliant object belonged is a remarkable one, for it furnishes many large fireballs in the summer months.

On July 18 at 11h. 33m. a meteor as bright as Jupiter was seen by Prof. A. S. Herschel at Slough, by Mr. H. S. Campbell at Croydon, and others. It was a most extraordinary object, for it had a very slow zigzag motion. It was very low in the air, for its computed heights were from 48 to 24 miles over Suffolk, and velocity only 7 miles per second.

On July 24 at 10h. 49m. a fine meteor, seen in its greatest splendour over the eastern counties of England, and considerably exceeding the lustre of Venus, fell from heights of 68 to 27 miles over the coasts of Essex and Norfolk. It had a path of about 103 miles, velocity 19 miles per second, and a radiant point at about 280°—15°.

JULY SHOOTING STARS.—The fine, hot weather prevailing during the last half of July enabled a large number of meteors to be recorded by Prof. A. S. Herschel, Mr. W. E. Besley, the writer at Bristol, and other observers. The earliest indication of the Perseids was noticed on July 16, and the shower gradually developed in intensity on later nights. The easterly motion of the radiant was distinctly traced. A fine Perseid was seen by Prof. Herschel at Slough, and by the writer at Bristol on July 19 at 11h. 49m. Its radiant was at 17° + 50°, and it fell from 81 to 54 miles. Another bright Perseid was recorded on July 24, 12h. 12m., by Prof. Herschel, Mr. W. E. Besley, and the writer, shooting from a radiant at 24° + 52°, and descending from 84 to 55 miles. Many interesting minor showers were seen in July. The most active display of all seen by the writer was that of the Aquarids from a radiant at 338°—10°, which furnished 23 meteors out of an aggregate of 177 observed between July 15—30. One of these was a very curious object. It appeared on July 24 at 11h. 3m., and looked like a small nebulous streak running slowly across the sky. Its path was 85 degrees long from 324° + 25° to 145° + 69°. The meteor seemed to be very feebly incandescent, and was directed from a radiant on the horizon at about 321°—33°.

THE FACE OF THE SKY FOR SEPTEMBER.

By A. FOWLER, F.R.A.S.

THE SUN.—Sun-spots and faculæ may be looked for, but they are not likely to be either numerous or large. On the 1st the sun rises at 5.14 and sets at 6.46; on the 30th he rises at 6.0 and sets at 5.40. He enters Libra, and Autumn commences at noon on the 23rd.

THE MOON.—The moon will enter first quarter on the 2nd at 7.56 A.M.; will be full on the 9th at 5.6 A.M.; will enter last quarter on the 15th at 8.57 P.M.; and be new on the 23rd at 7.57 P.M. The principal occultations are as follows, that of Saturn on the 3rd being especially notable:—

Date.	Name.	Magnitude.	Disappearance.	Angle from North.	Angle from Vertex.	Reappearance.	Angle from North.	Angle from Vertex.	Moon's Age.
				°	°		°	°	d. h.
Sept. 3	Saturn	—	7.16 P.M.	128	126	8.11 P.M.	217	206	9 16
,, 4	ξ¹ Sagittarii	5·0	7.35 P.M.	62	66	8.50 P.M.	271	263	10 16
,, 13	13 Tauri	5·4	9.43 P.M.	59	99	10.34 P.M.	273	314	19 18

THE PLANETS.—Mercury is not well placed for observation this month. He will be in superior conjunction with the sun on the 13th.

Venus is a morning star, reaching greatest westerly elongation of 46° on the 17th. The time of rising is about 1.30 A.M. throughout the month. She passes from Gemini into Cancer about the 4th, and into Leo about the 26th, the path being towards Regulus. At the middle of the month the diameter of the planet is 24".4, about half the disc being then illuminated.

Mars rises shortly before midnight during the greater part of the month. The path of the planet is easterly, passing from Gemini into Cancer about the 19th. On the 5th the planet will be near Delta Geminorum, less than a degree to the north of the star. On the 15th the apparent diameter of the planet is 5".2, and the illuminated part 0.915; the distance of the planet from the earth will then be nearly 168 millions of miles.

Jupiter remains an evening star, in Scorpio, but as it sets about half-past nine at the beginning of the month, and shortly before eight o'clock at the end of the month, there will probably be few opportunities of observing him. On the 1st, at 8 P.M., the planet will be in conjunction with the moon, 0° 51' to the north. The most notable satellite phenomena are a shadow ingress of the first satellite at 7.51 on the 4th, a transit ingress of the second satellite at 7.21 on the 12th, an eclipse reappearance of the second satellite at 7.18.38 on the 14th, and a transit egress of the first satellite at 7.13 on the 20th.

Saturn is also an evening star, in Sagittarius, but perhaps too low for useful observation. On the 1st the planet sets about 11 P.M., and on the 30th soon after 9 P.M. The planet is stationary on the 2nd, and in conjunction with the moon, 1° 5' south, at 8 P.M. on the 3rd. On the 22nd the planet is in quadrature with the sun.

Uranus is in quadrature with the sun on the morning of the 1st, and may perhaps be observed during the early evening. The planet sets soon after 9.30 P.M. on the 1st, and shortly before 8 P.M. on the 30th. The position of the planet is near Omega Ophiuchi.

Neptune is an evening star, in quadrature on the 22nd, rising shortly after 11 P.M. on the 1st, and about 9.17 P.M. on the 30th. The planet describes a short easterly path in Taurus, almost midway between 132 Tauri and Eta Geminorum.

THE STARS.—About 10 P.M. at the middle of the month, Auriga and Perseus will be in the north-east; Taurus low down a little north of east; Aries, Andromeda, and Cassiopeia towards the east; Pisces a little south of east; Cetus low down from east to south-east; Pegasus, south-east; Aquarius and Capricornus nearly south; Cygnus almost overhead; Aquila and Lyra nearly south-west; Hercules in the west; Corona and Boötis to the north of west; and Ursa Major nearly due north.

Minima of Algol will occur on the 17th at 12.8 A.M., and on the 19th at 8.57 P.M. Omicron Ceti (Mira) may be expected to be at or near a maximum.

Chess Column.

By C. D. LOCOCK, B.A.

Communications for this column should be addressed to C. D. Locock, Netherfield, Camberley, and be posted by the 10th of each month.

Solutions of August Problems.

No. 1.

1. Kt to R4, and mates next move.

No. 2.

(A. F. Mackenzie.)

1. B to R5, and mates next move.

B to QB7 also appears to solve this problem.

[This problem was selected in haste and, following the example of the *British Chess Magazine*, whence it was taken, erroneously given as a three-mover. Solutions in three moves are of course adjudged correct.]

XUM

CORRECT SOLUTIONS of both problems received from Alpha, K. W., H. S. Brandreth, H. Le Jeune, J. Baddeley, G. W. Middleton, W. de P. Crousaz.

Of No. 1 only from G. A. Forde (Capt.), J. T. W. Claridge, J. Humble.

G. A. FORDE (Capt.).—1. B to K7 will not solve No. 2 in two moves if Black replies by moving the Kt to Q3. The Bishop blocks the way of the Queen to Q6, and the Rook is undefended.

MAX JUDGE.—The King cannot move into check in the position which you enclose, or under any circumstances. It is true that the Pawn is pinned, but the Black King would be taken *first* if, as you suggest, both players are breaking the intended rules. If Black is allowed to move into check, White would be allowed to capture the King even if he thereby exposes his own King to the risk of *subsequent* capture.

A. C. WATERS.—See remarks on the problem above. Seventeen seems a reasonable number of solutions in three moves for a problem intended to be solved in two.

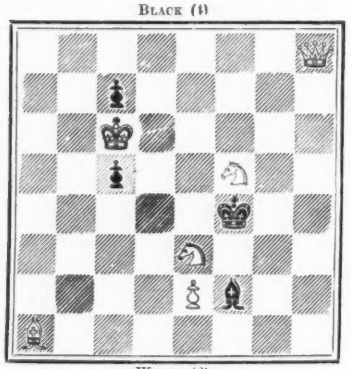
W. I. M.—No doubt chess affords an excellent logical training for the mind, but I should scarcely go so far as to recommend it in preference to the study of Mill's Logic.

PROBLEMS.

No. 1.

By N. M. Gibbins (Brighton).

BLACK (4)



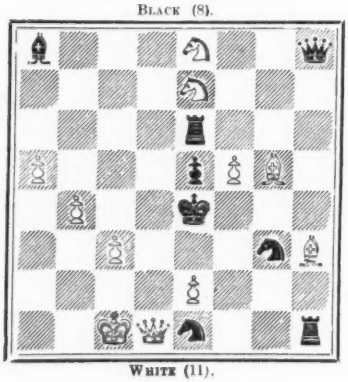
WHITE (6)

White mates in two moves.

No. 2.

By C. D. Locock.

BLACK (8).



WHITE (11).

White mates in two moves.

CHESS INTELLIGENCE.

The International Tournament at Munich was brought to a conclusion with the following result:—

H. N. Pillsbury	12	Tie for first, second, and third prizes.
C. Schlechter	12	
G. Maroczy	12	
A. Burn	10½	Fourth prize.
G. Marco	10	Fifth prize.
W. Cohn	8	Sixth prize.
D. Janowski	7½	Tie for seventh and eighth prizes.
J. W. Showalter	7½	
J. Berger	7½	
Wolf	7½	
Gottschall	6½	
Popiel	6½	
C. Halprin	6	
M. Billecard	3	
C. Von Bardeleben	2	
Jacob	1½	

The tie for the first three prizes has to be played off, each player contesting two games against each of the others. Pillsbury won the first game against Maroczy.

An examination of the score sheet shows that most of the prize-winners have come out in their correct places, judging by their form in the recent Paris tournament. Janowski has again come out lower than in previous years, while V. Bardeleben is evidently no longer the fine player he was when he held his own in tournaments against the very best masters some years ago. His health has no doubt broken down, and he has frequently retired before the conclusion of recent tournaments.

The Northern Counties Chess Union have challenged the Southern Counties to a correspondence match between teams of fifty aside, each pair to play two games simultaneously. The challenge has been accepted, and the match will begin early in October. Strong players desirous of having their names placed before the Selection Committee should write at once to Mr. T. M. Brown, 6, Wellington Place, Eccleshill, Bradford (North), or Dr. J. W. Hunt, 93, Richmond Road, Dalston, N.E. (South). The qualification is birth in one of the northern or southern counties, or a *bonâ fide* residence for the past twelve months.

The Chess Editor would be glad to receive some original problems in two or three moves for publication in this column. The talented composers who have contributed in this way for some years past have in many cases failed to send their customary problems this year. It is sincerely hoped that the omission will shortly be supplied.

The death is announced of William Steinitz, for many years champion chess player of the world. We hope to give a notice of his career next month.

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